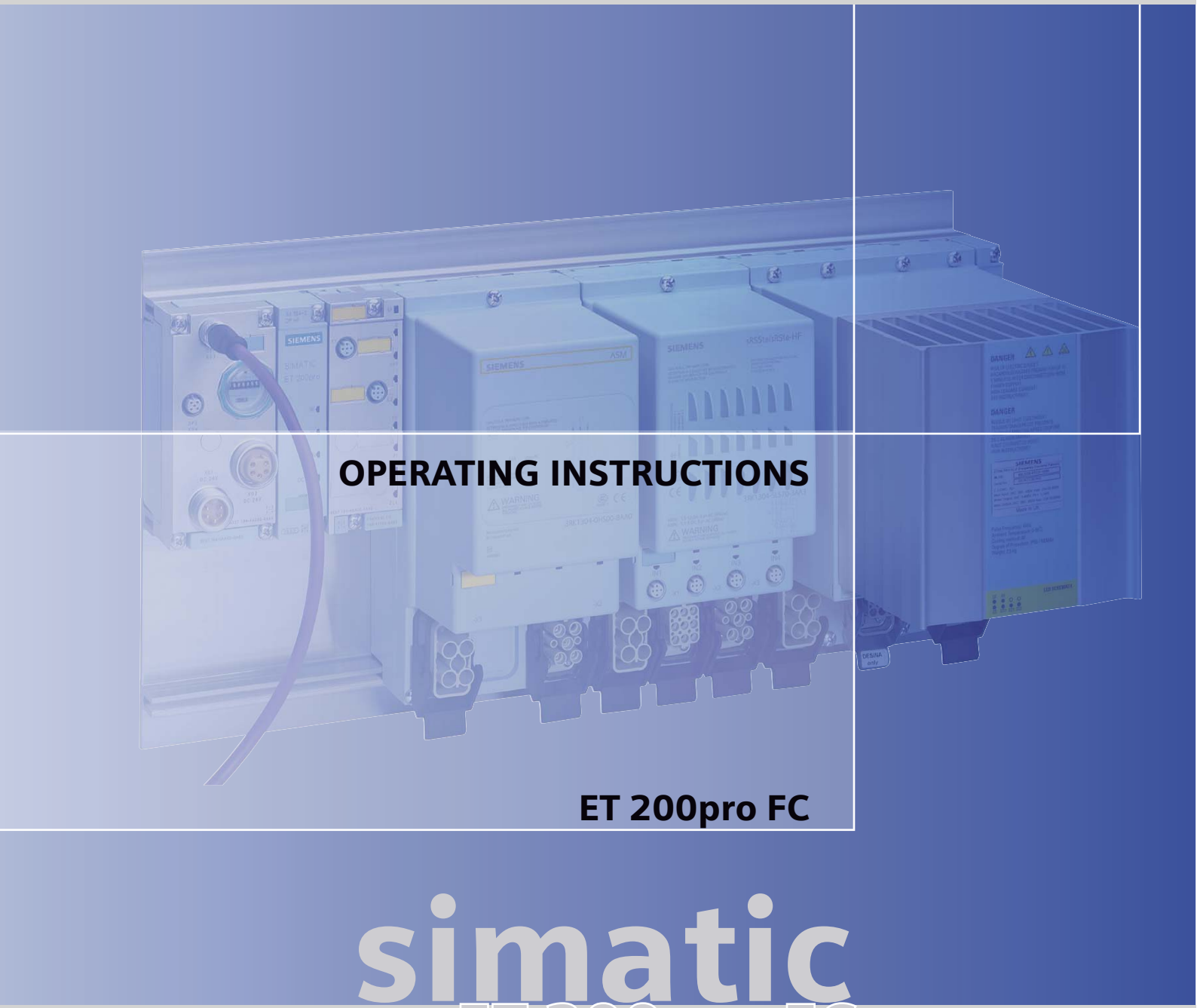
Operating Instructions · 11/2007



OPERATING INSTRUCTIONS

ET 200pro FC

simatic

ET 200pro FC

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Product Information

SIMATIC ET 200S FC
SIMATIC ET 200pro FC

Edition 11/2007

This product information sheet describes the behavior of the above mentioned inverters (Firmware version V3.0), that is not described in the associated documentation, edition 11/2007, Firmware version 3.0.

All inverters

If in sensorless vector control (SLVC) one of the following problems appears

- motor does not ramp up
- setpoint jumps at low frequencies at ramp down
- motor does not ramp down to 0 Hz even if torque limit is set to 0
- the calculated motor temperature (P0621 > 0) shown in r0035 is implausible

this can be caused by faulty values for both, stator and motor cable resistance.

Try the following to solve the problem:

- disconnect the motor from the feeder cable,
- measure the stator resistance and the motor cable resistance with an ohmmeter or better with a wheatstone bridge
- put the values in P0350 (stator resistance) and P0352 (cable resistance),
- then perform "calculation of motor parameters" again with P0340 = 3.

If you don' not get feasible values measuring the stator resistance, use the equivalent circuit data of the motor (this can be can be provided by the motor manufacturer) and write it into the respective parameters (fig 6.1 in Function Manual) or reduce the stator resistance in 5 % steps and perform "calculation of motor parameters" again with P0340 = 3.

Fail-safe inverters

If activating SS1 or SLS, this triggers the STO signal as a pulse. This STO pulse has no influence on the SS1 or SLS function and can be ignored.

Parameterization

The parameter length for an ET 200 station is 244 Bytes; when this limit is exceeded the module diagnosis of the ET 200 Frequency converter will not work.

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Frequency converters ET 200pro FC

Operating Instructions

Firmware version V3.0

11/2007
A5E01100763B AA

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Safety Guidelines

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠DANGER
indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠WARNING
indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠CAUTION
with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

CAUTION
without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

NOTICE
indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The device/system may only be set up and used in conjunction with this documentation. Commissioning and operation of a device/system may only be performed by **qualified personnel**. Within the context of the safety notes in this documentation qualified persons are defined as persons who are authorized to commission, ground and label devices, systems and circuits in accordance with established safety practices and standards.

Prescribed Usage

Note the following:

⚠WARNING
This device may only be used for the applications described in the catalog or the technical description and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens. Correct, reliable operation of the product requires proper transport, storage, positioning and assembly as well as careful operation and maintenance.

Trademarks

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Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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Automation and Drives
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90327 NÜRNBERG
GERMANY

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℗ 12/2007

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Technical data subject to change

Foreword

SIMATIC documentation

A wide variety of manuals is available for SIMATIC hardware and software.

You can access an overview of available documentation and languages, which is updated on a regular basis, by visiting us on the Internet at:
http://www.automation.siemens.com/simatic/portal/html_76/techdoku.htm.

The online catalog and ordering system are available at:
https://mall.automation.siemens.com/de/guest/guiRegionSelector.asp?lang=en/

Siemens offers various courses to get you started with the ET 200 and the SIMATIC S7 automation system. Information about our training courses is available on the Internet at:
http://www.sitrain.com/index_en.html

Information about FAQs (frequently asked questions) is available on the Internet at:
http://www.automation.siemens.com/simatic (under "Support" > "FAQ").

Internet address for SIMATIC

http://www.siemens.com/simatic

Target group

This publication is intended for project engineers, commissioners, machine operators, and service and maintenance personnel.

Purpose of the manual

The operating instructions impart knowledge about the components and allow the addressed target groups to properly and safely install, set up, test, and commission the SIMATIC ET 200.

Validity of the manual

This manual is valid for the specified components of the ET 200 decentralized I/O device.

The manual describes the components based on the data valid at the time of its release. We reserve the right to issue a Product Information which contains up-to-date information about new components and new versions of components.

For the sake of simplicity, this documentation does not contain all detailed information about all types of the product and cannot cover every conceivable case of installation, operation, or maintenance.

Experience required

General knowledge in the field of automation engineering and drive technology is required to understand this manual.

Recycling and disposal

Thanks to the fact that it is low in contaminants, the ET 200 is recyclable. For environmentally-compliant recycling and disposal of your electronic waste, please contact a company certified for the disposal of electronic waste.

Guide

You can quickly access specific information in the manual by using the following aids:

- At the beginning of the manual you will find a complete table of contents.
- Important terms are explained in the glossary.
- Navigate to the most important topics in this document using the index.

Special notes

In addition to this manual, you also need the manual for your DP master or I/O controller.

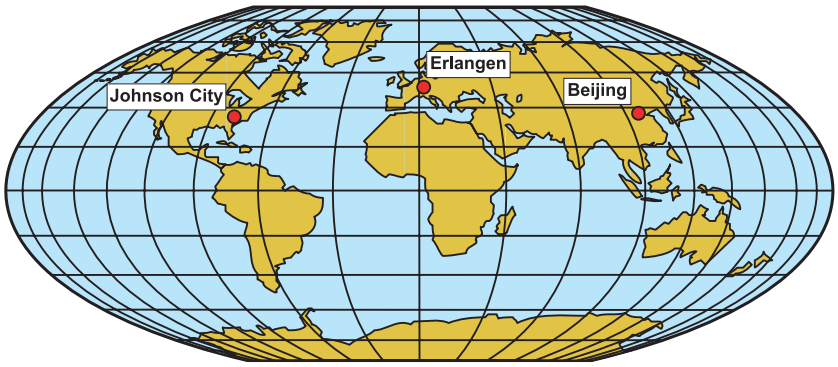
Position in the information landscape

The following table provides an overview of the contents of the ET 200pro-System manuals

Manual	Contents
ET 200pro distributed I/O devices	• Installing and connecting • Commissioning and diagnostics • Functions • Technical data – Interface modules – Power modules – Connection modules – Electronic modules
SIMATIC ET 200pro motor starters	• Installing and connecting • Commissioning and diagnostics • Device functions • Technical data – Backplane bus modules – Special modules – Motor starters
ET 200pro distributed I/O devices - fail-safe modules	• Configuring • Address assignment and installation • Diagnostics • Technical data – Fail-safe connection modules – Fail-safe electronic modules
ET 200pro interface modules IM 154	• Installing and connecting • Parameter assignment • Maintenance and servicing • Functions • Technical data
PROFINET system description	• PROFINET basics • Network components and structures • Data exchange and communication • PROFINET engineering
Migration from PROFIBUS DP to PROFINET IO	• Differences • Modules • System status lists • Diagnostics

A&D Technical support

24-hour technical support is provided by four main centers worldwide.



A&D Global service and support

Online Service and support

In the first instance for customer-support, contact should always be made with the regional (country based) sales/marketing/service organisations.

http://support.automation.siemens.com

For technical-support, the most optimised way to do this is via the Internet based Support-Request.

http://www.siemens.com/automation/support-request

Europe/Africa (Erlangen)

Internet Support-Request: http://www.siemens.com/automation/support-request

Tel: +49 (180) 5050 222

Fax: +49 (180) 5050 223

e-Mail: support.automation@siemens.com

America (Johnson City)

Internet Support-Request: http://www.siemens.com/automation/support-request

Tel: +1 (423) 262 2552

Fax: +1 (423) 262 2589

e-Mail: support.usa.automation@siemens.com

Asia/Pacific (Beijing)

Internet Support-Request: http://www.siemens.com/automation/support-request

Tel: +86 (1064) 757 575

Fax: +86 (1064) 747 474

e-Mail: support.asia.automation@siemens.com

Contact address

Should any questions or problems arise while reading this manual, please contact Siemens at the following address:

Siemens AG
Automation & Drives
A&D SD SPA PM4
Postfach 3269
D-91050 Erlangen
Germany

e-Mail: documentation.sd@siemens.com

Regional contacts

For questions regarding services, prices and conditions of technical support, please contact your local Siemens partner.

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Safety information

1

Safety instructions

The warnings, safety information and remarks that follow are intended to be used as both safety measures for users and as measures that can be put in place to avoid damage to the product or to components of the connected machines. The following section provides an overview of warnings, safety information and remarks that are generally applicable to any work involving the ET 200pro FC product: these are divided into general instructions and instructions for transportation and storage, commissioning, operation, repair, disassembly, and disposal.

Particular warnings and danger notices, as well as remarks on certain actions, will be given at the beginning of each relevant chapter of these Operating Instructions. In all sections, these will be repeated or expanded upon at key points.

Please read this information carefully: it has been included with your own personal safety in mind and in order to help you extend the service life of both your ET 200pro FC product and the machines that are connected to it.

General information

⚠WARNING

These devices carry hazardous voltages and control rotating mechanical parts which can be dangerous in some circumstances. Non-observance of the warnings or non-compliance with the instructions in this manual can lead to danger to life, serious injury or substantial damage to property.

Protection by means of SELV/PELV in case of direct touching is permitted only in areas with equipotential bonding and in dry interior spaces. If these conditions are not fulfilled, other protective measures against electric shock are to be taken, e.g. protective insulation.

Only suitably qualified personnel who have previously familiarized themselves with all the instructions regarding safety, installation, operating and maintenance as set out in this manual are permitted to work on these devices. Successful and safe operation of these devices depends on their proper handling, installation, operation and maintenance.

If an RCD (also called ELCB or RCCB) has been installed, the power module works without switching-off inadvertently provided the following preconditions have been met:

- A type B residual current operated circuit-breaker is used.
- The response limit current of the RCD is 300 mA.
- The neutral conductor of the network has been grounded.
- Only one power module is supplied via each RCD.
- The shielded output cables are shorter than 15 m.

The power-supply, direct-current and motor terminals as well as the brake cables and thermistor cables can carry hazardous voltages even when the converter is out of service. After interruption of the power supply, wait at least 5 minutes until the device has discharged itself. Only then carry out installation work.

It is strictly forbidden to isolate the device from the supply on the motor side; isolation from the supply must always be carried out on the supply side of the converter.

Before the power supply for the converter is connected, it must first be ensured that the terminal box of the motor has been connected.

This device is designed to ensure internal motor-overload protection in accordance with UL508C. See P0610 and P0335; i^2t has been set to ON as the standard setting.

If an LED or similar indicator does not light up or is not active when a function is switched from ON to OFF, this does not mean that the unit has been switched off or is current-free.

The converter must always be properly grounded.

The device must be isolated from the power supply before any cables, plugs or wires are connected to the device or altered.

Make sure that the converter has been configured for the correct supply voltage. It must be ensured that the converter is not connected to a higher supply voltage.

Static discharge on surfaces or at interfaces which are not generally accessible (e.g. terminals or connector pins) can cause malfunctioning or defects. The ESD protective measures should therefore be observed during work with converters or converter components.

The general and regional installation and safety regulations for working on equipment carrying hazardous voltages (e.g. EN 50178) as well as the relevant stipulations regarding the correct use of tools and personal protective equipment (PPE) are especially to be observed.

⚠ CAUTION

Children and other unauthorized persons must be forbidden access to the devices!

It is only permissible to use these devices for the purpose indicated by the manufacturer. Unauthorized changes and the use of spare parts and accessories which are not sold or recommended by the manufacturer of the device can lead to fires, electric shock and injuries.

NOTICE

This manual is to be kept somewhere close to the devices and must be easily accessible for all users.

If measurements or tests have to be carried out on the live device, the stipulations of safety regulation BGV A2 are to be complied with, especially § 8 "Permissible deviations during work on live parts". Suitable electronic tools are to be used.

Before installation and commissioning, please read this safety information and the warnings carefully as well as the warning signs fitted to the devices. It must be ensured that the warning signs are always legible; any signs that are damaged or missing are to be replaced.

Transport and storage

⚠ WARNING

Correct transport, storage as well as careful operation and maintenance are essential for the proper and safe operation of the equipment.

⚠ CAUTION

Protect the equipment against physical shocks and vibration during transport and storage. It is important that the equipment is protected from water (rainfall) and excessive temperatures.

Repairs

⚠ WARNING

It is not permissible to open the frequency converter. If the frequency converter is nevertheless opened, a new one must be used in order to ensure retention of the same degree of protection.

Description

2

2.1 The frequency converter

Description

The ET 200Pro FC is a compact frequency converter that is completely embedded in the distributed I/O system of the ET 200pro. The individual components can be configured in STEP 7 HW Config or integrated into other configuration systems using a GSD (device master file).

The frequency converters are available in two versions:

- Standard
- Fail-safe

The frequency converter works with an input voltage of 3 AC 400 V 50/60 Hz and can be used for 3-phase motors up to 1.1 KW, with temperature derating up to 1.5 KW.

Special features of the frequency converter

The power unit of the frequency converter feeds the braking energy from the motor back into the line supply system. A braking resistor, which transforms energy accumulated during regenerative operation into heat, is not necessary. The frequency converter can be operated without a line reactor.

Commissioning and operation

The commissioning software STARTER is used for commissioning. It can be downloaded from the Siemens homepage or ordered on a data carrier. It parameterizes the frequency converter through a fieldbus or a point-to-point connection. You have the option of reading the parameters for operating the frequency converter from the EEPROM of the frequency converter or from a Micro Memory Card (MMC) that is inserted in the frequency converter. A higher-level controller (e.g. SIMATIC S7) program is used to control the frequency converter.

Characteristics

- Compact frequency converter in the SIMATIC ET 200pro system
- Easy installation
- Easy commissioning
- Interconnection of signals using BICO technology
- Selectable data sets

- Fast current limitation (FCL) for trip-free operation
- Energy recovery into line supply system
- No braking resistor required
- Robust EMC design
- Can be configured for a wide range of applications
- Powerfail-proof storage of parameter settings on either EEPROM or MMC
- Control and diagnostics using a higher-level controller (e.g. SIMATIC S7)
- Diagnostics through LEDs
- High pulse frequencies for low-noise motor operation (default setting: 4 kHz), can be set between 2 kHz and 16 kHz
- Optical interface with USS protocol for commissioning with STARTER

Commissioning functions

- Quick commissioning
- Calculating the motor/controller data
- Motor data identification
- Application commissioning
- Series commissioning
- Parameter reset to default settings

Operating functions

- Adjustable setpoint channel
- Adjustable ramp function generator (RFG)
- Jog mode
- Free function blocks (FFB)
- Positioning ramp down
- Automatic restart (AR) function
- Flying restart
- Current limiting
- Slip compensation
- Motor holding brake (MHB)
- Regenerative braking

Additional features of fail-safe frequency converters

- Safe Torque Off (STO)
- Safe Stop 1 (SS1)
- Safely Limited Speed (SLS)

Function modules

- Vector control (speed and torque control) without encoder
- V/f control with different characteristics

Protective functions

- Motor protection functions
- Frequency converter protection functions
- System protection functions

Interfaces

- PROFIBUS or PROFINET through backplane bus
- MMC as parameter memory
- Optical interface with USS protocol
- Motor temperature sensor PTC or KTY84

Additional features of fail-safe frequency converters

Inputs for evaluating the switch-off signals from fail-safe ET 200pro modules (e.g. F-Switch or F-RSM)

Note

These inputs are an interface to the backplane bus and not directly accessible.

2.2 Components for assembling a frequency converter

General information

The following section provides an overview of configuration options for the frequency converters in the ET 200pro distributed I/O system.

Other general information on the ET 200pro distributed I/O system can be found in the manual entitled "ET 200pro Distributed I/O System".

For the purpose of selecting the components of an ET 200pro distributed I/O system, we recommend the "SIMATIC ET 200 Configurator" tool.

The ET 200pro system contains a large number of components which the user can combine according to his needs. The minimum configuration of a frequency converter requires a rack, a complete interface module including a bus terminating module (in the scope of supply of the IM), the bus module of the frequency converter and the frequency converter itself. The components described below represent the minimum configuration of a standard frequency converter.

More information can be found on the ET 200pro website and in the general ET 200pro manual.

Standard frequency converter

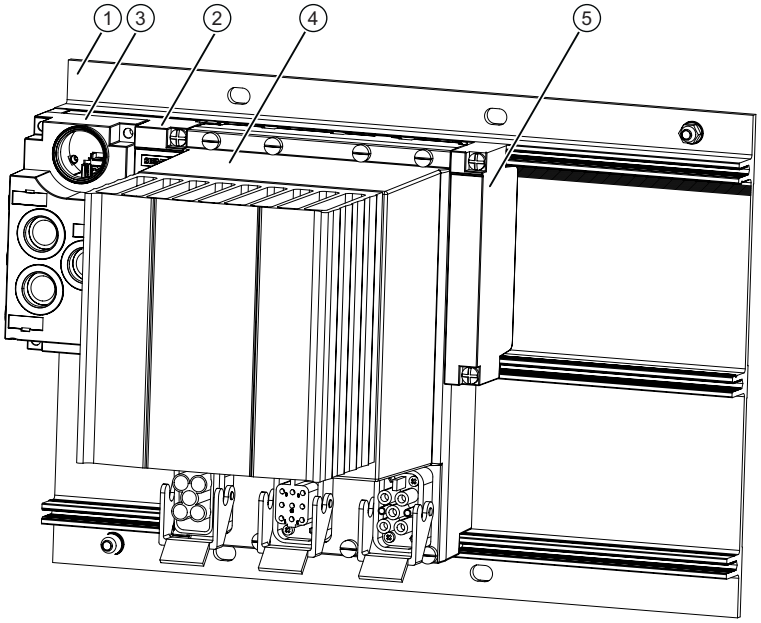


Figure 2-1 Standard frequency converter

Table 2-1 Components of the standard frequency converter

Illustration	Components	Function
1	Rack, wide	The ET 200pro bus modules, onto which the electronic modules are screwed, must be mounted on the rack. Lengths: 0.5 m, 1 m

Illustration	Components	Function
2	Interface module for PROFINET DP, with bus module	The interface module interconnects the ET 200pro with the DP master and prepares the data for the electronic modules. The unit is delivered with the terminating module, and the interface module is already mounted on the bus module. • The bus module is the mechanical and electrical connection element between the various ET 200pro modules. The following interface modules are available for PROFIBUS DP: • IM154-1 DP • IM154-2 DP HF
3	Connection modules for interface modules	The connection modules are mounted on the interface modules. They are used to connect PROFIBUS DP, the electronics/encoder supply and the load voltage supply. Available connection modules: • Direct connection: – CM IM DP Direct • ECOFAST: – CM IM DP ECOFAST Cu – CM IM DP M12, 7/8"
4	Frequency converter with bus module	The frequency converter is connected to the higher-level controller by way of the bus module and interface module. Power and motor are connected using prefabricated cables
5	Terminating module	The ET 200pro bus is terminated with the terminating module

Fail-safe frequency converter

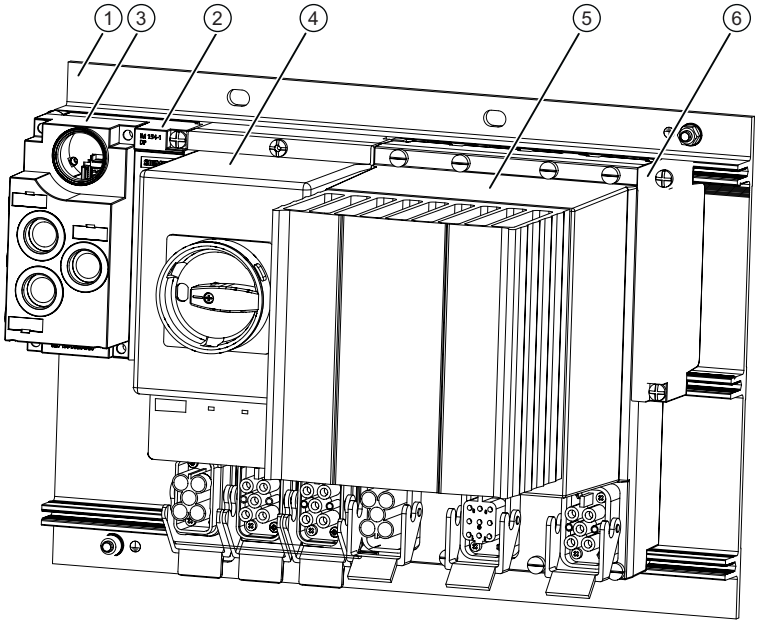


Figure 2-2 Fail-safe frequency converter with F-RSM

Table 2-2 Components of the fail-safe frequency converter with F-RSM

Illustration	Components	Function
1	Rack, wide	The ET 200pro bus modules, onto which the electronic modules are screwed, must be mounted on the rack. Lengths: 0.5 m, 1 m
2	Interface module for PROFINET DP, with bus module	The interface module interconnects the ET 200pro with the DP master and prepares the data for the electronic modules. The unit is delivered with the terminating module, and the interface module is already mounted on the bus module. • The bus module is the mechanical and electrical connection element between the various ET 200pro modules. • The terminating module terminates the ET 200pro. The following interface modules are available for PROFIBUS DP: • IM154-1 DP • IM154-2 DP HF
3	Connection modules for interface modules	The connection modules are mounted on the interface modules. They are used to connect PROFIBUS DP, the electronics/encoder supply and the load voltage supply. Available connection modules: • Direct connection: – CM IM DP Direct • ECOFAST: – CM IM DP ECOFAST Cu – CM IM DP M12, 7/8"
Not illustrated	Interface module for PROFINET IO, with bus module	The interface module interconnects the ET 200pro with the IO controller and prepares the data for the electronic modules. The interface module and connection module are shipped as a compact unit. The terminating module is included. The interface module is mounted on the bus module. Interface module available for PROFINET IO: • IM154-4 PN HF
4	Safety Local repair switch module (F-RSM), with bus module	The F-RSM is used to trigger the safety functions of the fail-safe frequency converter through the backplane bus; it switches the power bus for the following motor starters and frequency converters. An F-RSM must always be plugged in the system to the left of the frequency converter and can be controlled only through local safe inputs (Safety Local function).
5	Frequency converter with bus module	The frequency converter is connected to the higher-level controller by way of the bus module and interface module; power and motor are connected using prefabricated cables
6	Terminating module	The ET 200pro bus is terminated with the terminating module

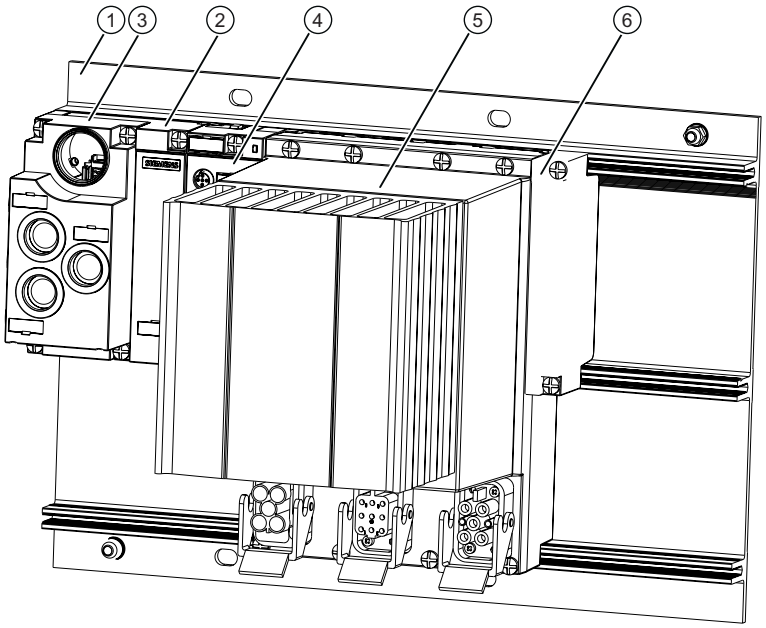


Figure 2-3 Fail-safe frequency converter with F-Switch

Table 2-3 Components of the fail-safe frequency converter with F-Switch

Illustration	Components	Function
1	Rack, wide	The ET 200pro bus modules, onto which the electronic modules are screwed, must be mounted on the rack. Lengths: 0.5 m, 1 m
2	Interface module for PROFINET DP, with bus module	The interface module interconnects the ET 200pro with the DP master and prepares the data for the electronic modules. The unit is delivered with the terminating module, and the interface module is already mounted on the bus module. • The bus module is the mechanical and electrical connection element between the various ET 200pro modules. • The terminating module terminates the ET 200pro. The following interface modules are available for PROFIBUS DP: • IM154-1 DP • IM154-2 DP HF
3	Connection modules for interface modules	The connection modules are mounted on the interface modules. They are used to connect PROFIBUS DP, the electronics/encoder supply and the load voltage supply. Available connection modules: • Direct connection: – CM IM DP Direct • ECOFAST: – CM IM DP ECOFAST Cu – CM IM DP M12, 7/8"
Not illustrated	Interface module for PROFINET IO, with bus module	The interface module interconnects the ET 200pro with the IO controller and prepares the data for the electronic modules. The interface module and connection module are shipped as a compact unit. The terminating module is included. The interface module is mounted on the bus module. Interface module available for PROFINET IO: • IM154-4 PN HF
4	Fail-safe I/O module, with bus module F-Switch	The F-Switch is used in conjunction with the frequency converter only for the purpose of switching control signals from the higher-level controller through PROFIsafe onto the internal switch-off signals F0 and F1 on the ET 200pro backplane bus.
5	Frequency converter with bus module	The frequency converter is connected to the higher-level controller by way of the bus module and interface module. Power and motor are connected using prefabricated cables
6	Terminating module	The ET 200pro bus is terminated with the terminating module

2.3 Limit / maximum expansion of the ET 200pro modules that can be connected

Maximum expansion for each IM 154 interface module

When configuring the system, please note the following:

- One ET 200pro station can be configured with up to 16 modules for each IM154 interface module. These include:
  - Power modules
  - Frequency converters
  - Electronic modules
  - Motor starters and special modules
- Up to 5 frequency converters can be mounted into one ET 200pro station.
- The maximum width of an ET 200pro is 1 m.

I/O address range of the ET 200pro frequency converters

The address range is 4 bytes.

Current carrying capacity of a 24 V potential group

The number of modules that can be connected depends on the total current of all of the modules of this potential group. This total may not exceed the maximum current carrying capacity.

Note

The current consumption of a frequency converter is max. 0.8 A.

If additional components belong to a particular potential group, e.g. a motor starter, then the current consumption of this component must be separately taken into account.

Current carrying capacity of a 400 V load group

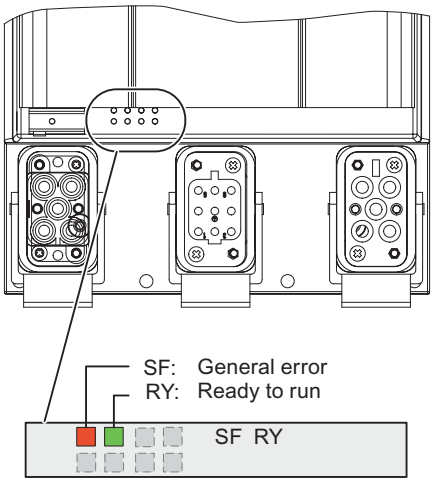
The total capacity of a load group (sum total of currents of all the loads in a load group) is 25 A (3 AC 400 V). If this value is exceeded, a new load group is required. With the frequency converter it is possible to relay the 400 V power supply to the next frequency converter/motor starter in the ET 200pro station.

2.4 Overview of the LEDs

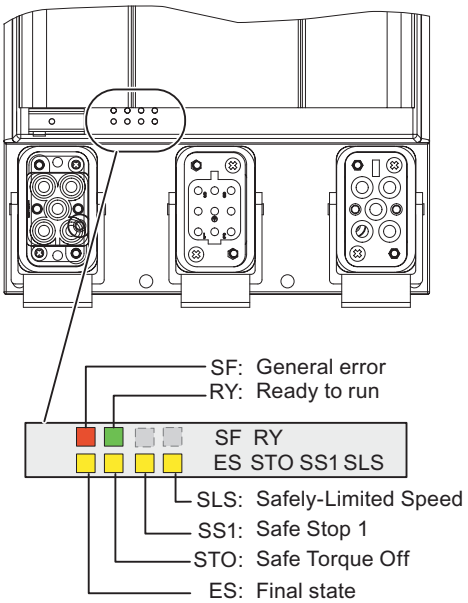
Status display through LEDs

The SIMATIC ET 200pro FC frequency converters have a number of functions and statuses that can be displayed by means of LEDs.

Standard frequency converter



Fail-safe frequency converter



Colors

The frequency converter status is displayed by means of the following range of LED colors and statuses:

Description	Color	Status		
		On	Off	Transitional status (Flashing: 0.5 Hz)
Fault LED • SF	Red			
Standby LED • RY	Green			
Fail-safe LED • ES • STO, SS1, SLS	Yellow			

Description of the LEDs

LEDs	Description
System failure (SF)	The "System failure" LED indicates a general system error in either the software or hardware.
Ready (RY)	The Ready LED indicates whether the converter is ready; a control word is sent for this purpose. It does not show whether the drive is running or not.
Final state (FS)	The "Final state" LED shows whether the final state of a safety function that has been triggered has been reached.
Safe torque off (STO)	The STO LED indicates the safety function "Safe Torque Off".
Safe Stop 1 (SS1)	The SS1 LED indicates the safety function "Safe Stop 1".
Safely Limited Speed (SLS)	The SLS LED indicates the safety function "Safely Limited Speed".

You can find safety function information in the Function Manual.

See also

Diagnostics through LEDs (Page 140)

Interfaces

3

3.1 Communication interfaces

Overview

The frequency converter has 3 communication interfaces. These are:

- An optical interface for commissioning the frequency converter using a PC and the RS232 interface
- A fieldbus connection

  Through the ET 200pro backplane bus for communicating with a higher-level control
- An MMC slot

  Slot for a special micro memory card (MMC). The MMC can be used as a parameter memory or for updating firmware.

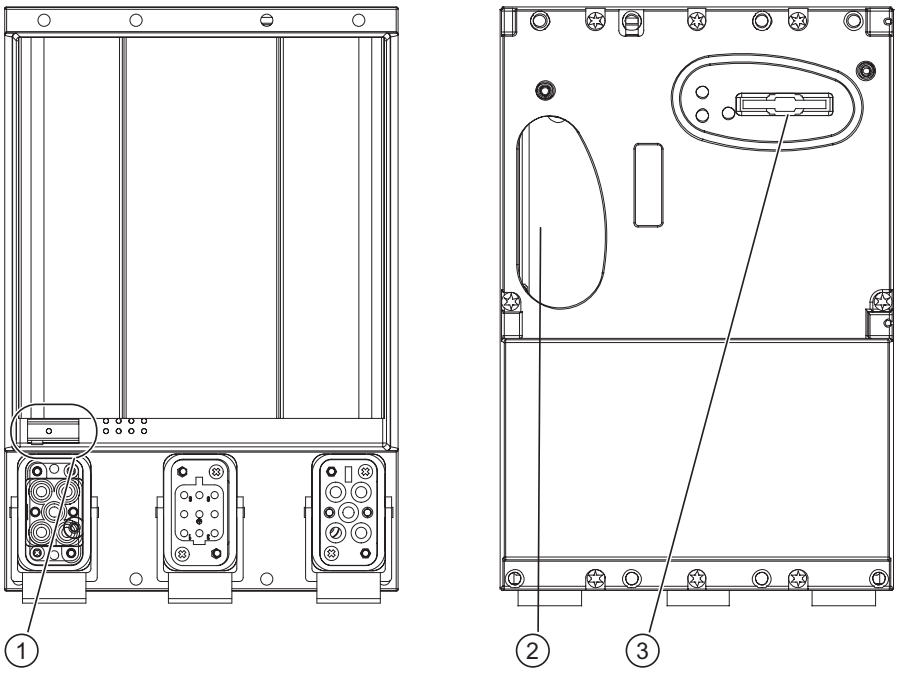


Figure 3-1 Interfaces on the ET 200pro

① Optical interface
② ET 200pro backplane bus
③ MMC

3.1.1 Optical interface

Description

The ET 200pro FC frequency converter has a serial optical communication interface with USS protocol for commissioning using the STARTER commissioning software on a PC. RS232/optical conversion is performed in the cable between the PC and the frequency converter.

The following components are required:

- PC with Windows 2000/Windows 2003 Server/Windows XP
- STARTER commissioning software (version 4.1 or higher)
- RS232 interface cable (Order No. 6RK1 922-2PB00).

3.1.2 Fieldbus interface (backplane bus)

Description

Communication between an ET 200pro station and the associated higher-level control (e.g. SIMATIC S7) is established using the standardized PROFIBUS DP communication protocol or PROFINET I/O. Communication within the ET 200pro system is performed over the ET 200pro backplane bus. The ET 200pro IM 154 interface module creates the interface between the two bus systems.

Communication data

The ET 200pro FC frequency converter is operated and controlled in normal process mode via PROFIdrive profile 4.0 with standard telegram 1.

The PROFIdrive profile with the standard telegram 1 provides the following functionality:

- Sending control words and setpoints with a fixed length to the drive
- Receiving status words and actual values with a fixed length from the drive
- Indicating drive faults through data record 47
- Reading/writing parameters via data set 47.

Note

Parameter values are transferred in acyclic data exchange through data record 47.

Standard diagnostics

The frequency converter can be included in the standard diagnostics of S7.

3.1.3 MMC interface (Micro Memory Card)

Description

The MMC interface can be used to back up frequency converter parameters on an external MMC and, if required, download them back onto the frequency converter.

Possible fields of application for the MMC

The MMC can be used as a parameter memory:

- Uploading a parameter set onto an MMC
- Transferring parameters from an MMC when exchanging the frequency converter
- Automatic download of a parameter set from an MMC.

Note

Several parameter sets can be stored on an MMC. The file name clone00.bin is used in the default setting. Other names can be set via P0804 (e.g., clone00.bin to clone99.bin).

Inserting the MMC

Precondition: The frequency converter must be disassembled.

The label must be facing down when the chamfered edge of the MMC is pointing left.

The MMC must be pushed into the MMC slot as far as it will go; it can only then be removed by pressing the eject button.

3.2 PTC/KTY84 interface

The PTC/KTY84 interface can be used as an option.

Description

The connection for a PTC/KTY84 sensor to the motor temperature monitor is integrated in the motor connector.

⚠WARNING

The motor temperature monitor is assigned to the line supply potential, dangerous touch voltages are thus possible.

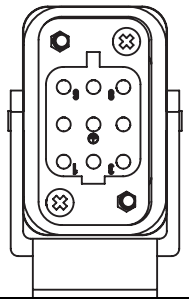
The frequency converter must be switched off-circuit before the motor temperature sensor can be connected.

3.3 Interface to the motor holding brake

Description

A motor holding brake can be controlled using the ET 200pro FC. The electrical connection between the frequency converter and the brake is established by plugging the motor cable into the frequency converter. Use of the motor holding brake is optional.

Table 3-1 Assignment of wiring from the temperature sensor and motor holding brake in the motor plug

Number	Pin X2 on the frequency converter
	HAN Q8/0 (socket)
	
1	U
2	Not assigned
3	W
4	Brake (-)
5	PTC/KTY84 (+)
6	Brake (+)
7	V
8	PTC/KTY84 (-)
⏚	PE

Installation

4

4.1 Prerequisites and maximum expansion

Maximum mechanical expansion

The maximum expansion of an ET 200pro is reached when one of the rules outlined below applies:

Table 4-1 Maximum mechanical expansion

Features	Rule
Number of modules	max. 16 electronic modules
Width of ET 200pro	max. 1 m mounting width (without rack)
Number of frequency converters	maximum 5

Maximum electrical expansion

- Electronic / encoder supply 1L+:
  - Powers the internal electronics of the frequency converters
  - Electrically isolated to the backplane bus of ET 200pro, to 2L+ and to PROFIBUS DP/PROFINET IO
- Load voltage supply 2L+:
  - Powers the safe inputs and outputs when a safety-orientated frequency converter is used
  - Electrically isolated to the backplane bus, to 1L+ and to PROFIBUS DP/ PROFINET IO

Table 4-2 Maximum electrical expansion

Features	Rule
Electronic/encoder supply 1L+	max. 5 A per ET 200pro station; a frequency converter requires 0.8 A
Load voltage supply 2L+ max. 10 A per ET 200pro station	The load caused by the frequency converter is negligible

There is no electrical limit for a station that has been expanded with a maximum of 5 frequency converters.

4.2 Mounting the racks

The frequency converter is mounted on the wide rack. The following versions are possible:

- Rack, wide
- Rack, compact-wide

Dimensions

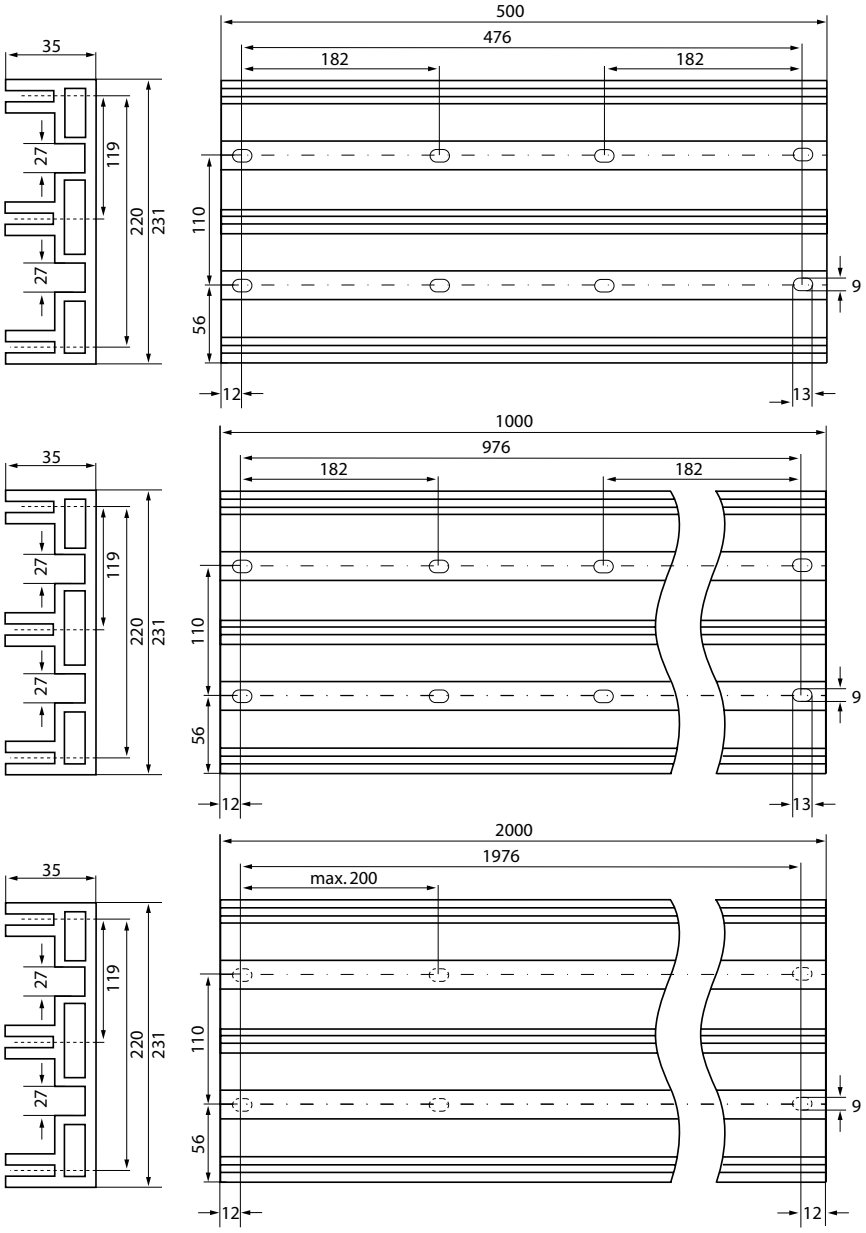


Figure 4-1 Dimensional drawing of compact-wide rack

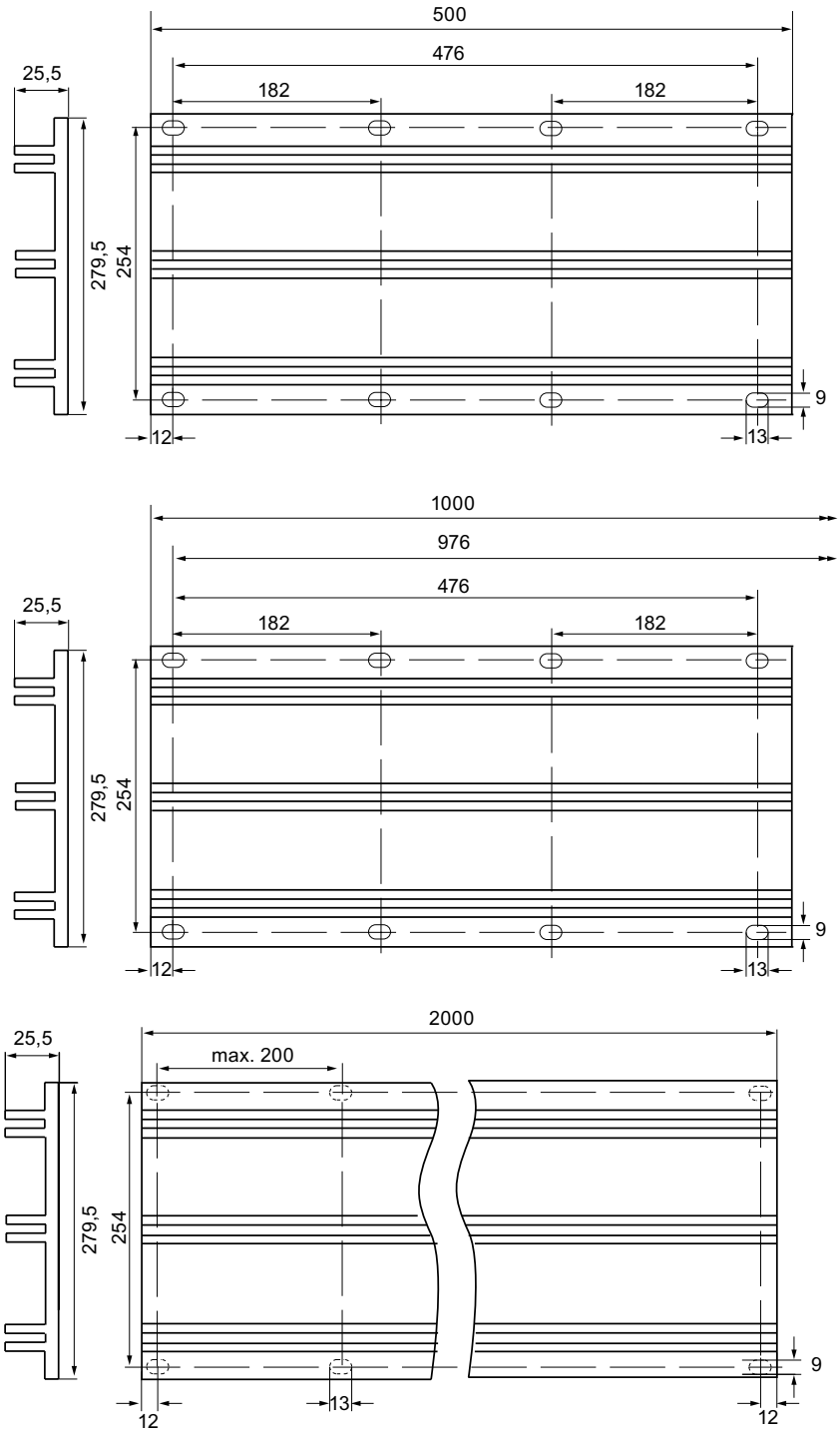


Figure 4-2 Dimensional drawing of wide module rack

Tools required

- Wrench or screwdriver, matching the selected fixing screws.
- Stripping tool and crimp tool for the grounding cable.

Accessories required

Table 4-3 Rack and grounding cable

For...	you can use ...	Explanation
Outer fixing screws	M8 cylindrical head screw according to ISO 1207/ISO 1580 (DIN 84/DIN 85)	Choose a suitable screw length for your configuration. You also need 8.4 mm washers according to ISO 7092 (DIN 433)
	Hexagonal head screw, M8, according to ISO 4017 (DIN 4017)	
Grounding cable	Insulated cable, conductor cross-section: min. 4 mm^2)	You also need an M8 ring cable lug and an M8 spring lock washer

Mounting the rack and connecting functional ground

1. If necessary, mark the mounting holes on the mounting base, then drill holes with diameter of 8.5 $mm^{\pm 0.2}$ mm.
2. Screw-mount (M8 screws) the rack onto the carrier.
3. Strip the grounding cable (Cu strip, for example) for your functional earth (FE) to a suitable length, then crimp an M8 lug onto the conductor.
4. Fasten the grounding cable using one of the bore holes of the rack: Slip the spring lock washer, the washer and the cable lug onto the mounting screw, then screw the rack onto the carrier.
5. Connect the opposite end of the grounding cable to ground potential.

Note

Ensure adequate equipotential bonding.

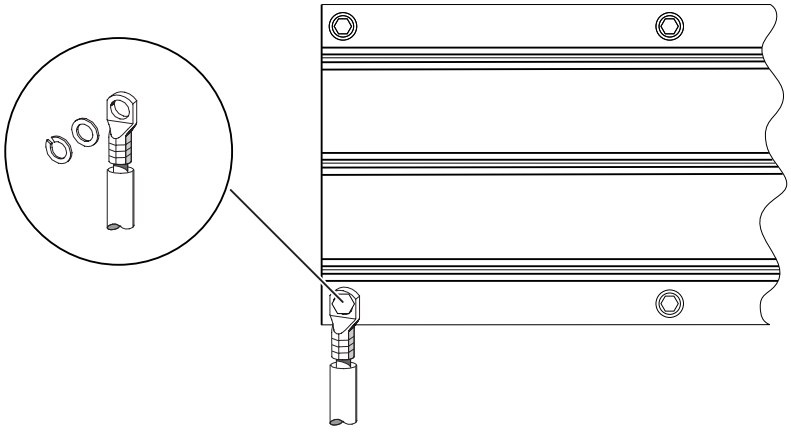


Figure 4-3 Grounding the wide rack

4.3 Mounting the interface module

The interface module connects ET 200pro to PROFIBUS DP/ PROFINET IO and supplies power to the electronic modules.

Requirements

- Interface module for PROFIBUS DP
  - The terminating module is removed from the interface module.
  - The rack has been mounted.
- Interface module for PROFINET IO
  - The terminating module is removed from the interface module.
  - The SIMATIC Micro Memory Card is inserted.
  - The rack has been mounted.

Required Tools

Cross-tip screwdriver, size 2

Procedure

1. Snap-mount the Interface module onto the rack, then slide it into the correct position
2. Screw-mount the Interface module onto the rack.

   Interface module for PROFIBUS DP (without connection module):
   2 recessed head screws on the front: top and bottom, tightening torque 1.5 N/m

   Interface module for PROFINET IO:
   All recessed head screws on the front: top and bottom, tightening torque 1.5 N/m

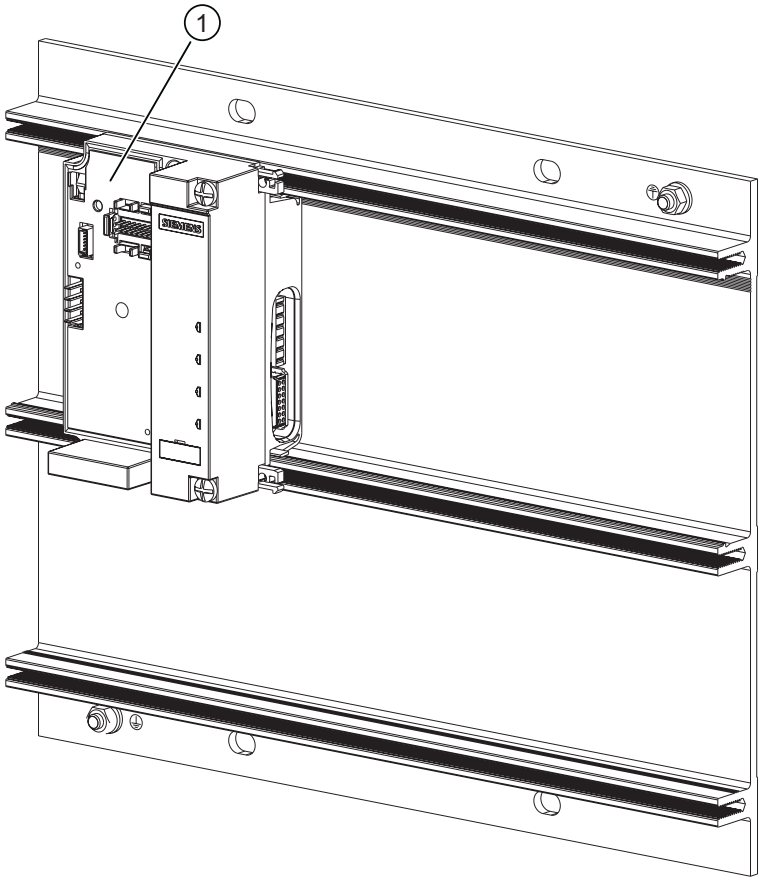


Figure 4-4 Installing the interface module for PROFIBUS DP (example)

① Interface module

4.4 Mounting the bus module

The bus module connects the frequency converter to the ET 200pro backplane bus.

Requirements

- The interface module is mounted on the rack.
- Additional bus modules can be mounted next to the interface module

Procedure

1. Snap-mount the bus module onto the rack.
2. Push the bus module to the left until it engages into the interface module or the previous electronic module.

Note

The bus module is first screwed together with the frequency converter to the mounting plate.

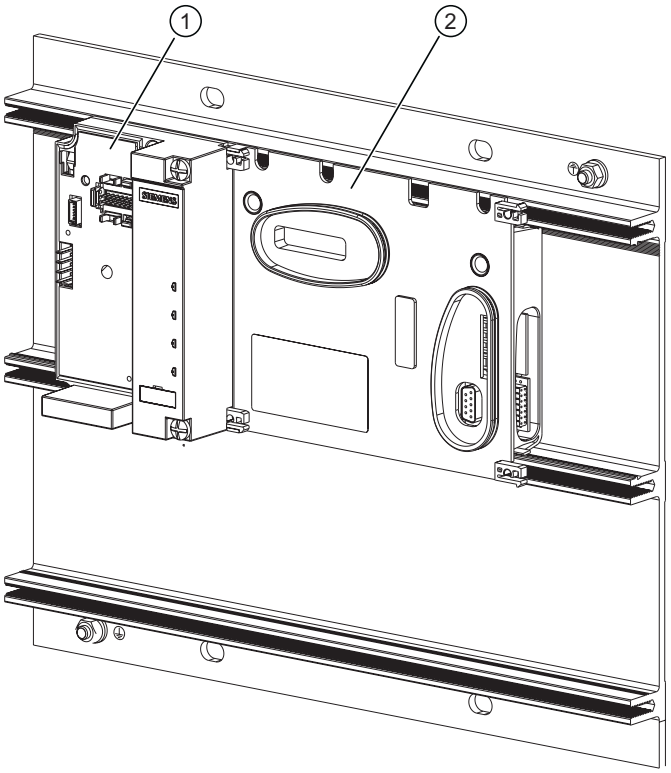


Figure 4-5 Mounting the bus module for frequency converters

① Interface module
② Bus module 155 mm

4.5 Mounting the terminating module

The ET 200pro station must be terminated with the terminating module.

Requirements

- All bus modules are mounted on the rack.

Required tools

Cross-tip screwdriver, size 2

Procedure

1. Mount the terminating module onto the rack.
2. Slide the terminating module to the left up against the last bus module.

Note

Do not screw the terminating module to the rack (2 recessed head screws at the front, torque 1.5 Nm) until all the bus modules are mounted and screwed in place.

The terminating module is included in the scope of delivery of the interface module.

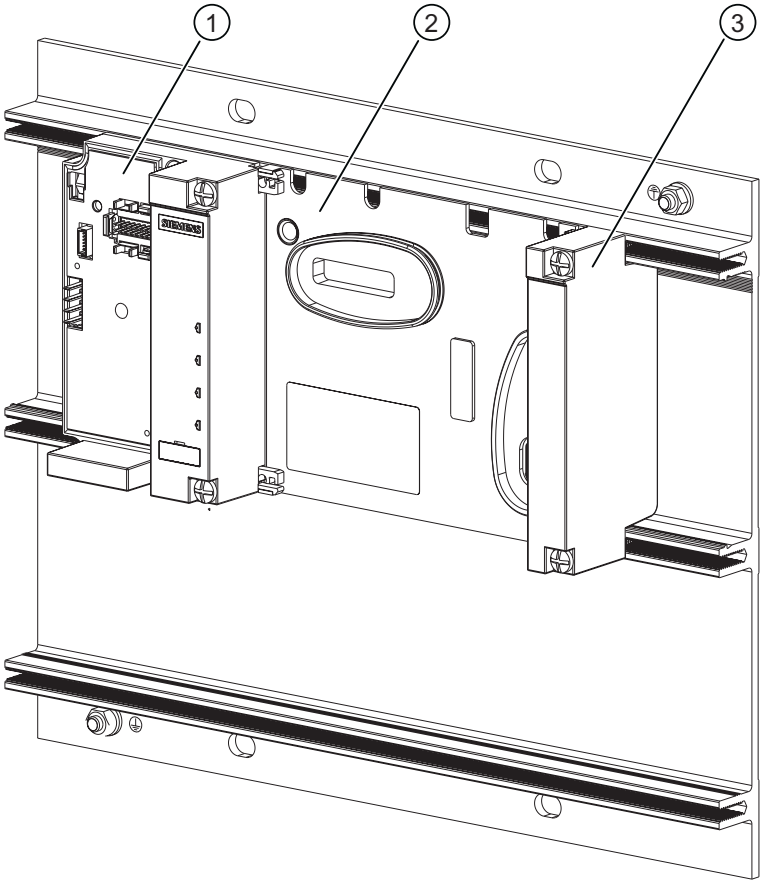


Figure 4-6 Mounting the terminating module

① Interface module
② Bus module 155 mm
③ Bus terminating module

4.6 Mounting the connection module for IM154

There are various connection modules with different connection methods for IM 154

- CM IM DP ECOFAST Cu
- CM IP DP M12, 7/8"
- CM IM DP Direct.

Requirements

The interface module must be mounted.

Required tools

Cross-tip screwdriver, size 2

Procedure

1. Make the settings depending on the connection module and establish the internal connections

   The settings and connections of all communication modules are described in the manual "ET 200pro Distributed I/O Devices"

2. Fastening the connection module with 4 screws

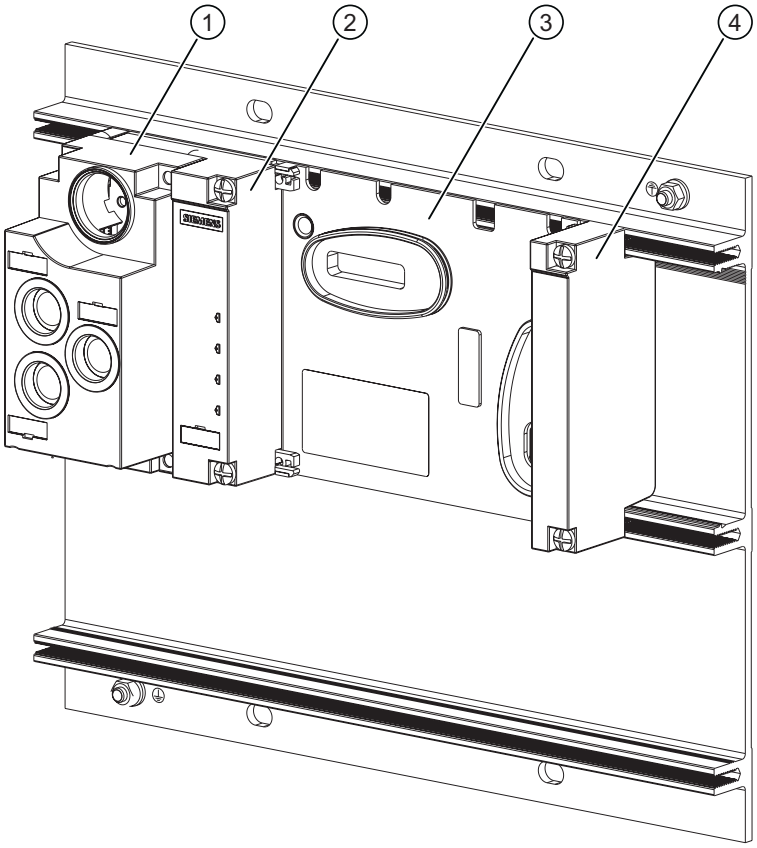


Figure 4-7 Mounting the connection module

① Connection module
② Interface module
③ Bus module 155 mm for frequency converters
④ Bus terminating module

4.7 Mounting the frequency converters

The frequency converter is unpacked and screwed onto the bus module using 8 screws.

Note

When removing the device from the packaging, be sure not to touch or damage the rear plug. Remove the device and place it on a even surface.

Figure 4-8 Taking the frequency converter out of the packaging

Figure 4-9 Placing the frequency converter on an even surface

Requirements

The bus module for the frequency converter and all the modules to the left are mounted.

Tools required

Cross-head screwdriver, size 2.

Procedure

1. Plug the frequency converter into the bus module so that the two domes on the rear engage in the guide holes of the bus module.
2. Holding the frequency converter firmly against the module rack, screw it in place with 4 screws on the top and 4 screws on the bottom. The upper 4 screws simultaneously fasten the bus module.

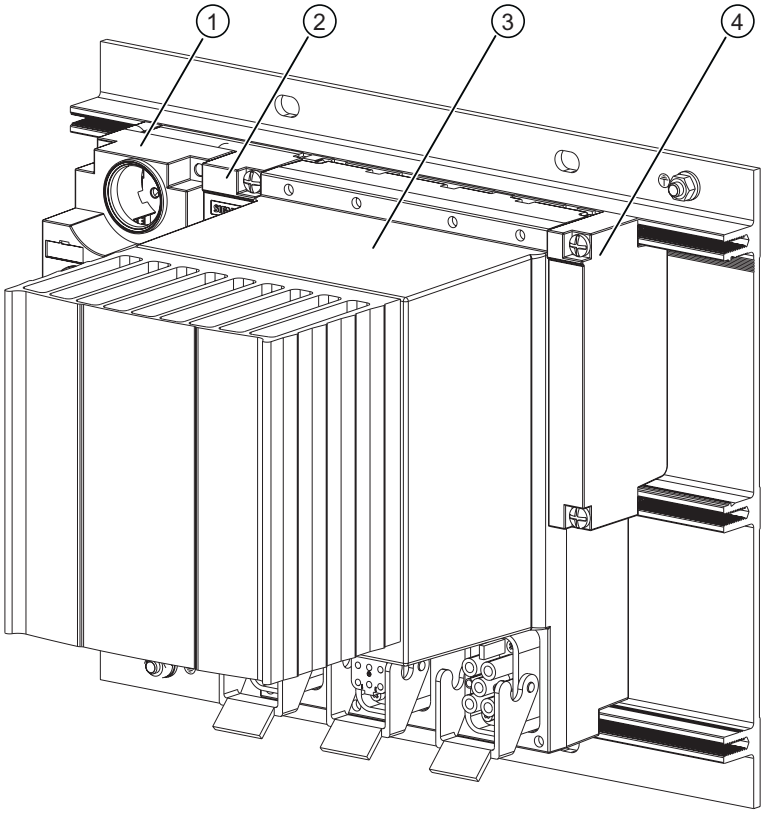


Figure 4-10 Mounting the connection module, interface module, terminating module and frequency converter

① Connection module
② Interface module
③ Frequency converter
④ Bus terminating module

4.8 Wiring in the ET 200pro system

Communication and auxiliary voltages are routed with standard connectors through the interface module (or power modules) and the backplane bus to the frequency converter and do not have to be considered here.

The power unit of the frequency converter is rated for direct operation on TN and TT line supply systems with a grounded PEN conductor with a rated voltage of 3 AC 400 V. In the case of systems where CE/EMC requirements are to be fulfilled, the prescribed shielded cables must be used. For this we recommend standard SY cables; the shield must be grounded at both ends and the perfect connection of the shielding must be checked.

The 400 V supply is connected using standard connectors:

- X1 line supply system input
- X2 motor connector (the cables for both the brake and the temperature sensor are integrated)
- X3 looped-through line supply system

Requirements

NOTICE
National Fire Protection Association (NFPA) compatibility These devices are only certified for installation in industrial machines in accordance with the "Electrical Standard for Industrial Machinery" (NFPA79). Due to their design features, it is possible that these devices cannot be installed in accordance with the National Electrical Code (NFPA70).

NOTICE
It is only permissible to use temperature-resistant copper cables for at least 75 °C.

- Motor cable: max. 15 m, shielded with metallic HAN 8 connector

  A hybrid cable is necessary when using a motor holding brake and/or PTC/KTY 84.
- Additional incoming line supply system:
  - If the 400 V infeed line, 4 mm² (AWG 12), is looped through within the ET 200 station; max. 25 A
  - If a single infeed line is used for a frequency converter or motor starter, 1.5 mm² (AWG 16) is sufficient.

Tools required

If you use prefabricated standard cables, no tools will be needed for the frequency converter side. You can adapt the motor side to your needs. If you want to prepare the cables yourself, the following tools, among others, will be needed.

Table 4-4 Tools

		Harting order no.
Crimping tool (Q8/0 and Q4/2)	--	0999 000 0001
Inserts for crimping tool	0.5 mm^2 (AWG 20)	0999 000 0007
	1.5 mm^2 (AWG 16)	0999 000 0007
	4 mm^2 (AWG 12)	0999 000 0006
	6 mm^2 (AWG 10)	without insert
Extraction tool (Q8/0)	--	0999 000 0319
Extraction tool (Q4/2)	--	0999 000 0305

Table 4-5 Power supply connector X1, X3

All plug-in connecting components are Harting Q4/2				
Enclosure	**Crimp size**	**Crimp number**	**Cap**	**Screw-type connection/seal**
0912 006 3141	Female connector for X1: 6 mm^2 (AWG 10)	0932 000 6208	0912 008 5408	0900 000 5059
	Male connector for X3: 4 mm^2 (AWG 12)	0932 000 6107	0912 008 5407	0900 000 5059

Table 4-6 Plug-in motor connector X2

All plug-in connecting components are Harting Q8/0				
Enclosure	**Crimp size**	**Crimp number**	**Cap**	**Screw-type connection/seal**
0912 008 3001	Male: 1.5 mm^2 (AWG 16)	0933 000 6104	0912 008 0502	0912 000 5057
	Male: 0.5 mm^2 (AWG 20)	0933 000 6121		

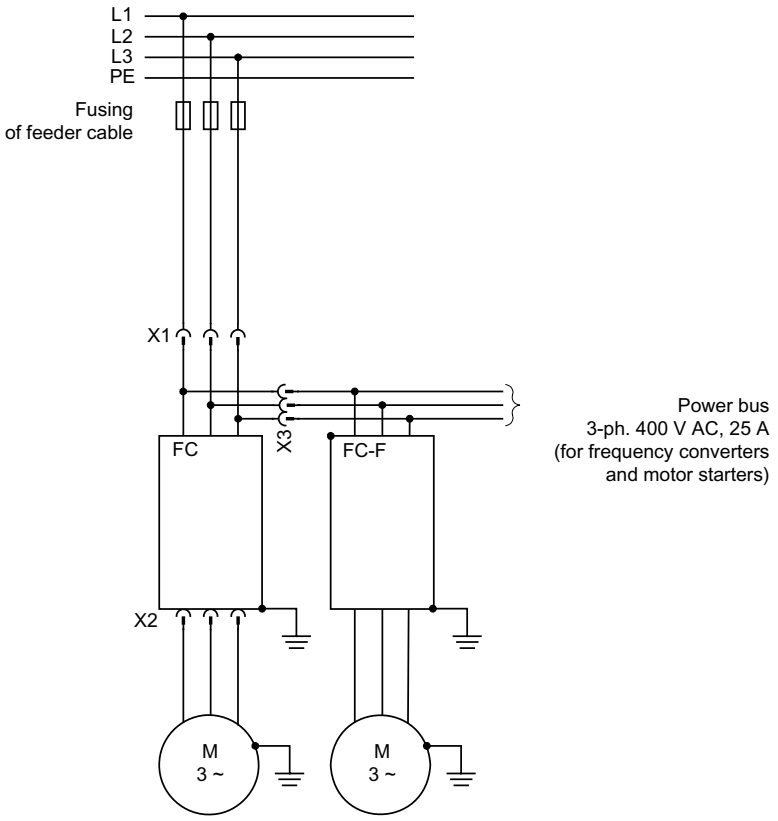
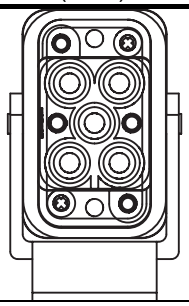
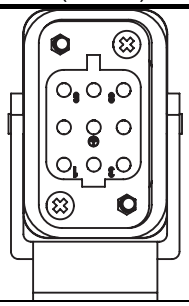
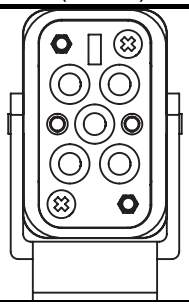


Figure 4-11 ET 200pro FC frequency converter

Table 4-7 Assignment of the main power connections on the frequency converter

Number	Connection X1	Connection X2	Connection X3
	HAN Q4/2 (male)	HAN Q8/0 (female)	HAN Q4/2 (female)
			
1	Phase L1	U	Phase L1
2	Phase L2	Not assigned	Phase L2
3	Phase L3	W	Phase L3
4	Not assigned	Brake (-)	Not assigned
5	--	PTC/KTY84 (+)	--
6	--	Brake (+)	--
7	--	V	--
8	--	PTC/KTY84 (-)	--
⏚	PE	PE	PE

Motor cable

Motor cable up to 10 m are available under the following order designation:

- 6ES7194-1LA01-0AA0 (1.5 m)
- 6ES7194-1LB01-0AA0 (3.0 m)
- 6ES7194-1LC01-0AA0 (5.0 m)
- 6ES7194-1LD01-0AA0 (10.0 m).

Larger lengths up to 15 m can be obtained from our service providers.

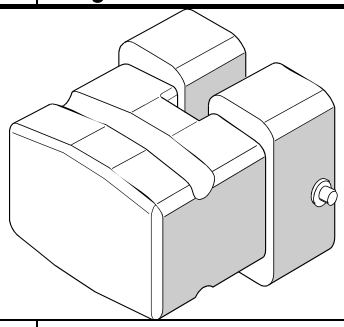
NOTICE
A metallic connector enclosure must be used for connecting. The shield of the motor cable must be connected to a large area of the motor housing (for EMC reasons).

Power transmission

The power jumper connector is used to loop-through the main power from one frequency converter/motor starter to the next frequency converter/motor starter.

The table below shows the assignment of the contacts:

Table 4-8 Power jumper connector

Pin	Socket	Assignment
		
1	1	Phase L1
2	2	Phase L2
3	3	Phase L3
4	4	Not assigned
⏚	⏚	PE

4.9 Mounting a fail-safe frequency converter

Fail-safe applications are configured basically the same as standard applications but with the following differences:

- Mounted to the left of the frequency converter must be a module through which the safety functions of the frequency converter can be actuated, for example:
  - an F-RSM repair switch module
  - an F-Switch
- Only the following modules are allowed to be connected between the F-RSM or F-Switch and the fail-safe frequency converter:
  - 400 V shutdown module
  - all direct or reversing starters
  - the standard frequency converter
  - the fail-safe frequency converter

Procedure:

Mount one after the other:

1. Rack
2. Interface module
3. Bus module for F-RSM or F-Switch
4. Bus module for frequency converter
5. Terminating module
6. Connection module for the interface module
7. F-RSM or F-Switch
8. Frequency converter

4.9.1 Mounting the bus module for F-RSM and mounting the repair switch module

The Safety Local function of the F-RSM, its use, control elements and connections are described in detail in the manual *SIMATIC ET 200pro Motor Starters*.

Therefore, only the most important points concerning its use with a frequency converter will be covered here.

The 3RK 19222-BA01 bus module is required to accommodate a Safety Local repair switch module. It is mounted to the left of the frequency converter bus module.

The Safety Local repair switch module is plugged onto its mounted backplane bus module (1) and screwed with 3 recessed head screws to the rack (2).

Note

Make sure that the seal is cleanly seated and that the recessed head screws are tightened with a torque of 1.5 Nm to ensure a tight arrangement.

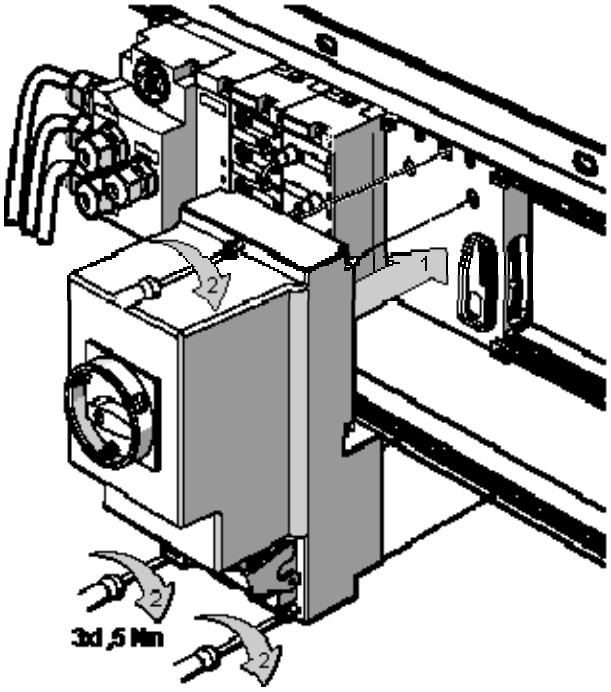


Figure 4-12 Mounting the repair switch module

Tools required

Cross-tip screwdriver, size 2

4.9.2 Mounting the module for the F-Switch

The function, use, control elements and connections of the F-Switch are described in detail in the manual *ET 200pro Distributed I/O Devices - Fail-safe Modules*

Therefore, only the most important points concerning its use with a frequency converter will be covered here.

The 6ES7 xxxxxxx bus module is required to accommodate an F-Switch. It is mounted to the left of the frequency converter bus module. Then the electronic module and the connection module are mounted.

Procedure

1. Plug the electronic module onto the bus module.
2. Plug the connection module onto the old electronic module.
3. Use a screwdriver, size 2, to screw the connection module onto the electronic module and bus module with the 2 recessed head screws using a tightening torque of 1.5 Nm.

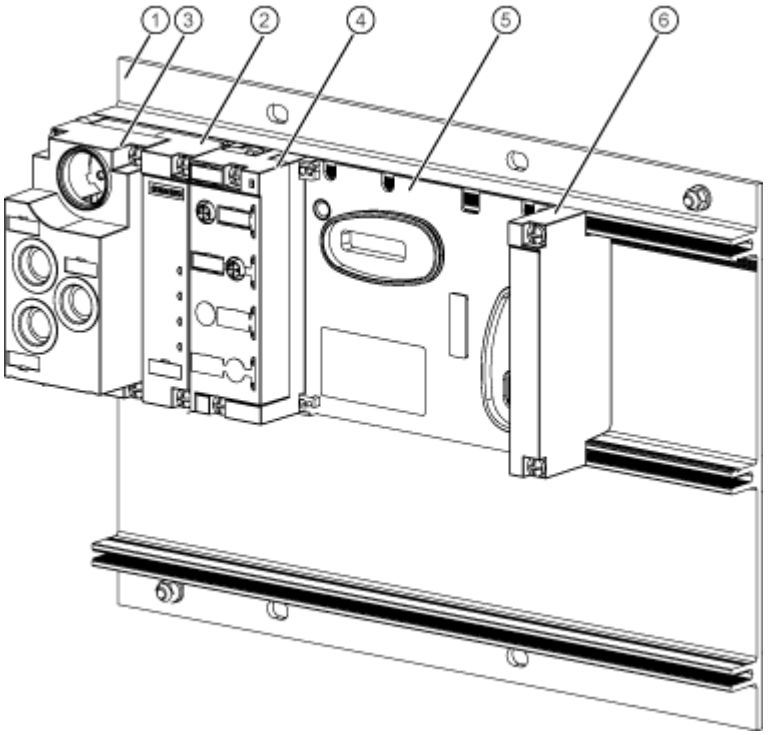


Figure 4-13 Modules for the F-Switch

Configuration / project engineering 5

5.1 Integrating ET 200 frequency converters into automation systems with STEP 7

General information on STEP 7

STEP 7 is the basic package for configuring and programming SIMATIC automation systems. It is part of the SIMATIC industry software. The STEP 7 basic package is available in several versions. "STEP 7 for applications running on SIMATIC S7 300/400" is required for integrating ET 200pro frequency converters. Additional information on STEP 7 is provided in the STEP 7 manuals.

Integrating frequency converters into SIMATIC S7

Frequency converters are integrated into the network of a SIMATIC S7 control system using STEP 7. Communication takes place either with the standardized communication protocol PROFIBUS DP or through PROFINET IO. In PROFIBUS, the SIMATIC automation device represents the master and the ET200pro station with the PROFIBUS interface module and other components (such as frequency converters or I/O modules) represents the slave. In PROFINET IO, the SIMATIC automation device is referred to as the IO controller and the ET 200pro station with PROFIBUS interface module and other components, e.g. frequency converters or IO modules, as the field device. Within the ET 200pro distributed I/O system, the frequency converter is contacted through the ET 200pro backplane bus.

Hardware components (SIMATIC and ET 200pro)

- SIMATIC S7 300 or SIMATIC S7 400 with integrated PROFIBUS DP/PROFINET IO interface
- ET 200pro with interface module
- ET 200pro FC frequency converter

Software components (SIMATIC and ET 200pro)

- STEP 7 Version 5.2, Service Pack 1 or higher plus hardware support package (HSP). The download takes place from HW Config in STEP 7. The correct link is preset there.
- Program library Drive ES

See also

Components for assembling a frequency converter (Page 24)

5.2 Installation of the hardware information in SIMATIC Manager

5.2.1 Installation of a hardware support package (HSP)

The HSP (hardware support package) file defines the system environment of an ET 200pro station. To be able to configure an ET 200pro with the HW Config tool, the relevant HSP file must be installed first.

- To do this, open the SIMATIC tool HW Config and go to "Install HW updates" in the "Options" menu.
- In the upper part of the window, select the source of the file (Internet or data carrier) and click "Execute". A new window opens. The HSP files found are displayed in a drop-down list box. Select the "ET 200pro" HSP and click "Copy" or "Download". You can then close this window.
- The copied HSP files will now be available in the drop-down list box of the window that you initially opened. Select the HSP files to be installed from the list of available files in the archive folder and click "Install". All STEP 7 applications will be closed automatically and the selected HSP files installed.

The next time you open the HW Config tool, the ET 200pro station will be in the hardware catalog under PROFIBUS DP.

5.2.2 Installation of a master device file (GSD)

The device description for the frequency converter is declared to HW Config in STEP 7 by installing the GSD (master device file) for use with PROFIBUS and the GSDML for use with PROFINET. If no HSP is installed for the frequency converter in the STEP 7 pack, or if the frequency converter is operated with a third party master, the device description for operation on PROFIBUS can be implemented by installing the GSD file. In this case the masks and the designation of the frequency converters differ from the S7 standard as described on the following page.

The following example demonstrates how the GSD can be input into HW Config of the SIMATIC.

- Open the program "HW Config".

  Close any projects which may be open there.
- Then select Options > Install GSD files in order to open the dialog box for installing GSD files and click "Browse" to select the location of the GSD file.
- Then select the file you want from the list and click on the button "Install".

  After the dialog is closed, the hardware configuration catalog is updated automatically and you can open your project.
- Install the GSD file in the required language (English, French, German, Italian, or Spanish) from the folder containing the relevant data.
- Selection of the telegram in the frequency converter is set using the parameter P0922 while the drive is commissioned. The receive telegram is in r2050[8] and the send telegram is set using the P2051[8] parameter.

5.3 Configuring the communication

The frequency converter is operated by means of PROFIdrive profile.

Table 5-1 Operation with standard telegram 1

Usable PLC	Any PLC
Possible fieldbus	PROFIBUS DP or PROFINET IO
Required blocks	None [1]
Communication between frequency converter and STARTER commissioning software	Optional on the field bus [2] [3] or across the RS232 port of the frequency converter
Cyclic communication between higher-level PLC and frequency converter	4 bytes For details, refer to the "Standard telegram 1" table
Acyclic communication with a higher-level PLC	DS 47 for transferring several parameters [2]
Default diagnostics	Channel-specific diagnostics (diagnostics number, slot number) with OB82 called in higher-level SIMATIC CPU in the event of a frequency converter fault

1 Optional: Drive ES block package
2 Only in PROFINET IO and PROFIBUS DPV1
3 Routing across one or several SIMATIC CPUs is not supported

Table 5-2 Standard telegram 1

	SIMATIC PLC → frequency converter		Frequency converter → SIMATIC PLC	
	Signal	Remark	Signal	Remark
PZD1	STW1	Control word 1	ZSW1	Status word 1
PZD2	NSET_A	Speed setpoint, 16 bit	NACT_A	Speed actual value, 16 bit

5.3.1 Generating a hardware configuration for PROFIBUS in the SIMATIC Manager

Description

The following example of an ET 200pro FC frequency converter with an "IM 154-2 DP HF" interface module will be used to demonstrate how to generate a PROFIBUS configuration with HW Config in the SIMATIC Manager. This will take place in three steps:

- Parameterizing the PROFIBUS DP interface in SIMATIC S7
- Equipping the ET 200pro station
- Settings for the frequency converter

Note

For information regarding the interface modules, please refer to the manual "ET 200pro Distributed I/O System", chapter "Interface modules".

Parameterizing the PROFIBUS DP interface in SIMATIC S7

The PROFIBUS DP interface is parameterized when configuring the hardware. When a CPU with integrated DP interface or a DP communication processor is selected from the hardware

catalog, a PROFIBUS DP system is provided in the hardware configuration. After setting the parameters for the master, the slave – in this particular case the ET 200pro station – must be selected from the hardware catalog and placed on the PROFIBUS line. This is done by inserting an IM 154. The PROFIBUS address of the ET 200pro station must also be specified in IM 154.

Inserting a master system through the context menu of the CPU's DP interface

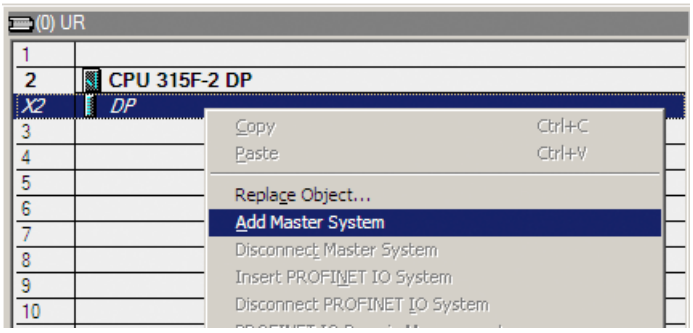


Figure 5-1 Master system

Inserting the ET 200pro system in the master system and specifying the PROFIBUS address

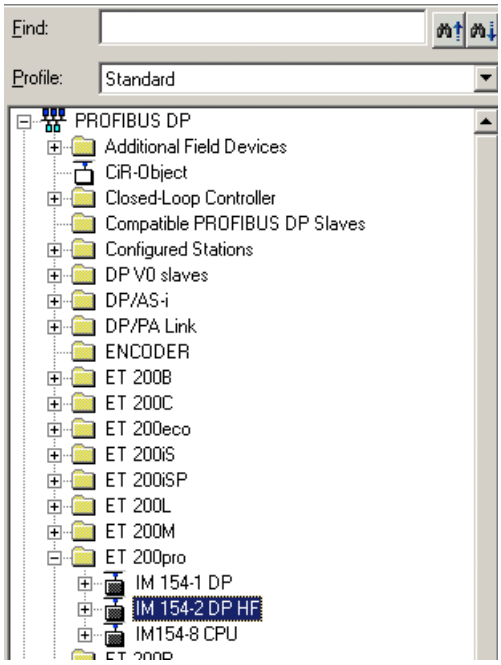


Figure 5-2 Selecting the ET 200pro from the hardware catalog

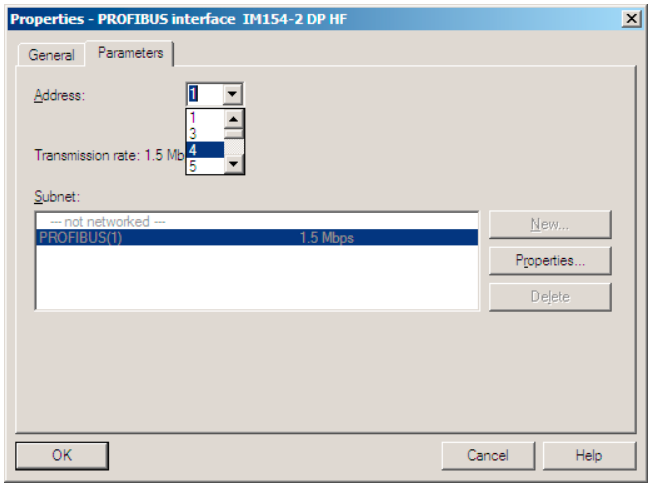


Figure 5-3 Allocating the slave address at the PROFIBUS DP

The configuration should now appear as follows:

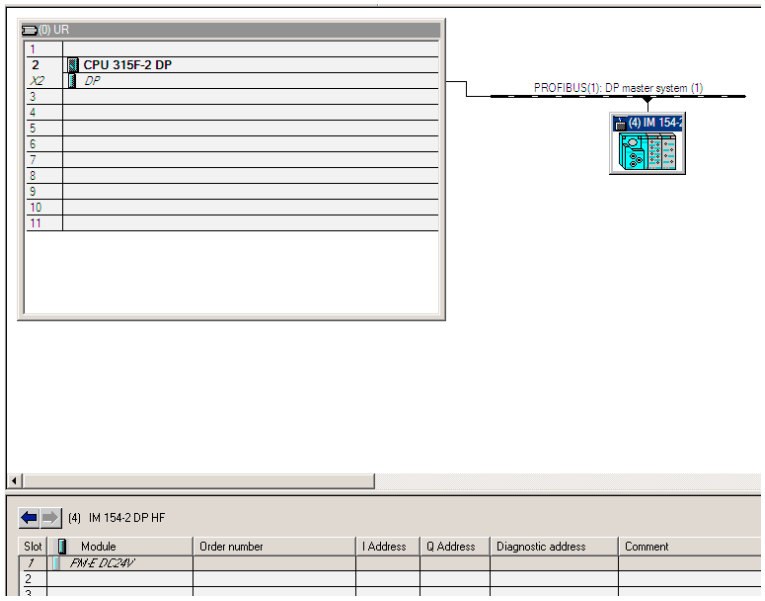


Figure 5-4 Configuration

Inserting a converter in an ET 200pro slot

From the hardware catalog select "FC 1.1/1.5 kW; standard telegram 1" and pull it onto the slot.

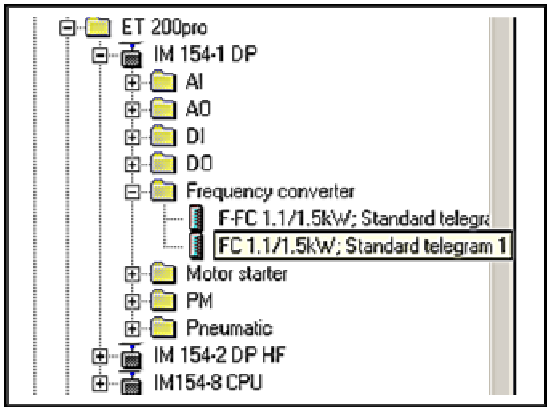


Figure 5-5 Selecting the frequency converter

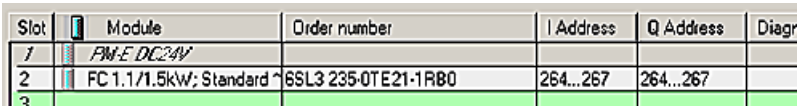


Figure 5-6 Frequency converter in slot

With this selection the user specifies which frequency converter will be used (standard or fail-safe).

Note

When a fail-safe application is configured, an F-RSM or F-Switch must be connected in front of the frequency converter.

Settings for the frequency converter

Double-clicking the frequency converter opens the property view with the following tabs:

- General
- Adresse
- Parameter.

Address/ID

Setting an address in the I/O map
The start address configured here is accepted in the user program as the "LADDR" input parameter for the blocks in the user program.

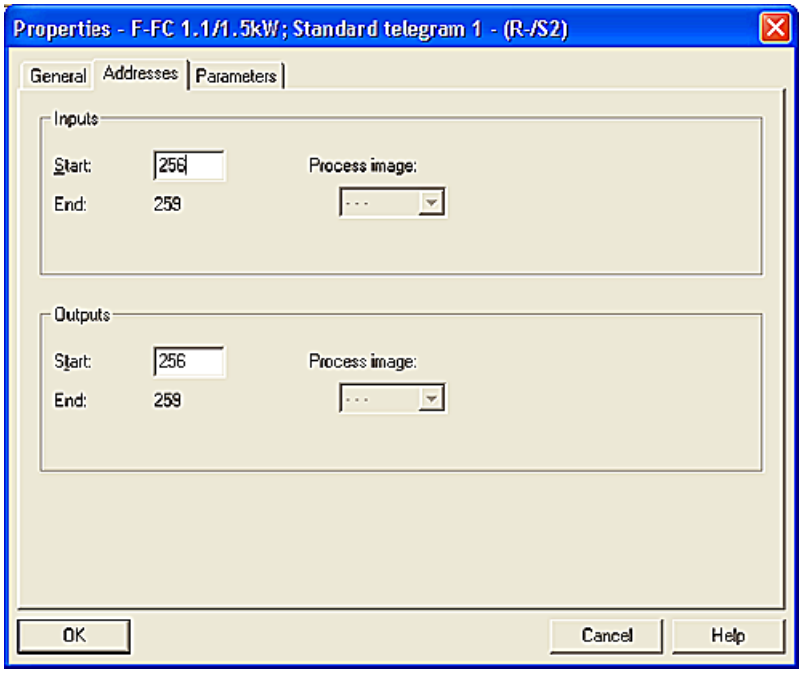


Figure 5-7 Setting the address in the I/O map

Note

The input and output address area of the frequency converter must be the same.

Parameter

The application ID provides a unique means of identification and is assigned by the user.

Note

If the same application ID is entered for several frequency converters, they can be used interchangeably. Frequency converters with the same application ID must be parameterized in the same way. Only frequency converters with the same parameters may be used interchangeably.

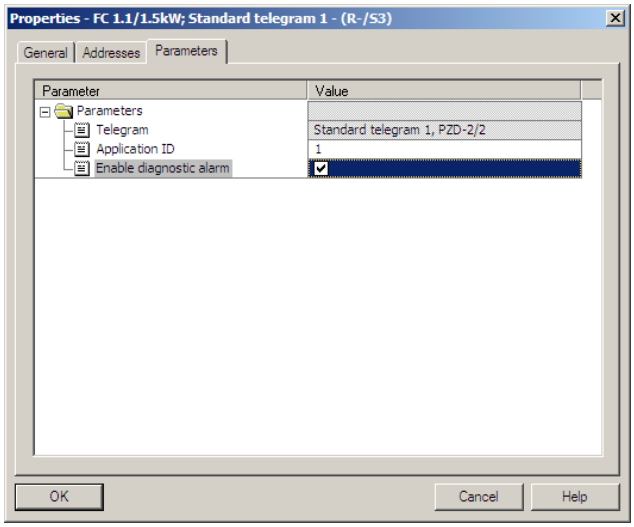


Figure 5-8 Parameter

Points to note when using the PROFIdrive profile

The alarm mode of the ET 200pro slave must be set to DPV1.

- Double-click the ET 200pro system
- Select the "Operating parameters" tab

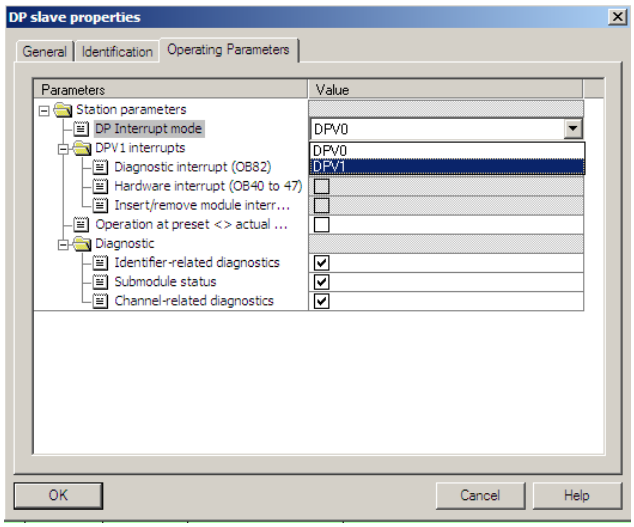


Figure 5-9 Operating parameters

- The diagnostic interrupt parameter of the frequency converter enables the S7 system diagnostics in PROFIdrive mode.
  - No diagnostic messages: 0
  - Diagnostic messages: 1.

Note

Enabled diagnostic messages require troubleshooting in the OB82 of the user program. (If there is no OB82 in the user program, the S7 enters the "STOP" state in the event of an error.)

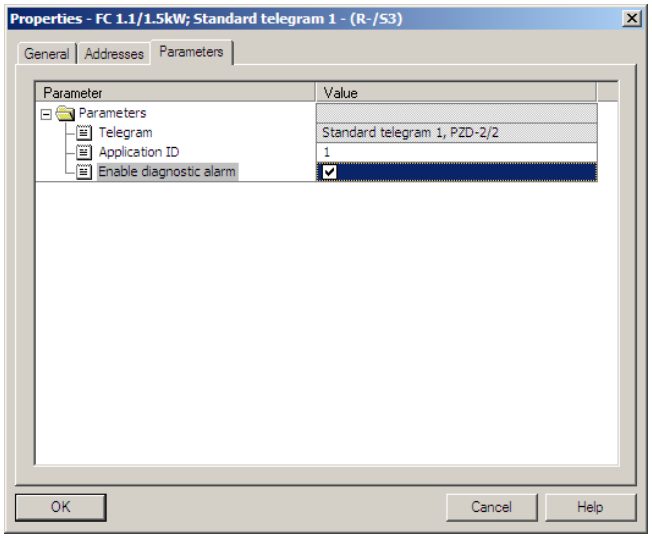


Figure 5-10 Setting the device-specific parameters

5.3.2 Generating a hardware configuration for PROFINET in the SIMATIC Manager

Description

The following example of an ET 200pro FC frequency converter with an "IM 154-4 PN HF" interface module will be used to demonstrate how to generate a PROFINET configuration with HW Config in the SIMATIC Manager. This will take place in three steps:

- Parameterizing the PROFINET IO interface in SIMATIC S7
- Equipping the ET 200pro station
- Settings for the frequency converter

Note

Please refer to the "Interface modules" chapter in the manual entitled "ET 200pro Distributed I/O System" for information on the interface modules.

Parameterizing the PROFINET IO interface in SIMATIC S7

The hardware configuration is used to parameterize the PROFINET IO interface. When a CPU with an integrated DP interface or a DP communications processor is selected from the hardware catalog, a PROFINET IO system is made available in the hardware configuration. Once the parameters for the IO controller have been set, the slave - in this case, the ET 200pro station - must be selected from the hardware catalog and positioned on the PROFINET line. This is done by inserting an IM 154. The PROFINET address of the ET 200pro station must also be specified in IM 154.

Inserting the IO controller using the context menu of the CPU PROFINET IO interface

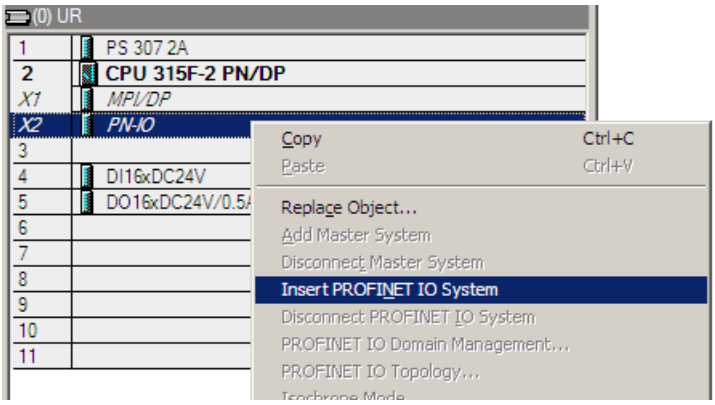


Figure 5-11 Inserting an IO Controller

After the PROFINET IO system was inserted, a network must be created for it. In the context menu of the PN-IO click on "Object properties". In the window which then opens, click the "General" tab and then the "Properties" button to create a new network.

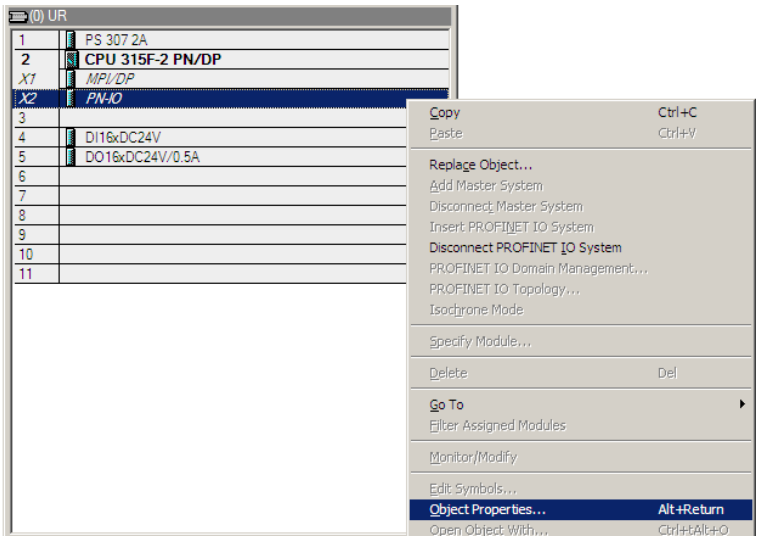


Figure 5-12 Creating a network

Inserting the ET 200pro system in the IO Controller

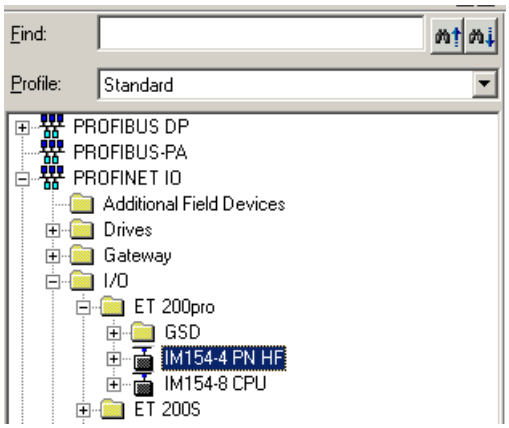


Figure 5-13 Selecting the ET 200pro from the hardware catalog

Specifying the device name

In the PROFINET version, the address of the I/O devices is assigned via their device names. To do this, click the ET 200pro station in the HW Config tool to open its properties. You can then enter any unique device name you like.

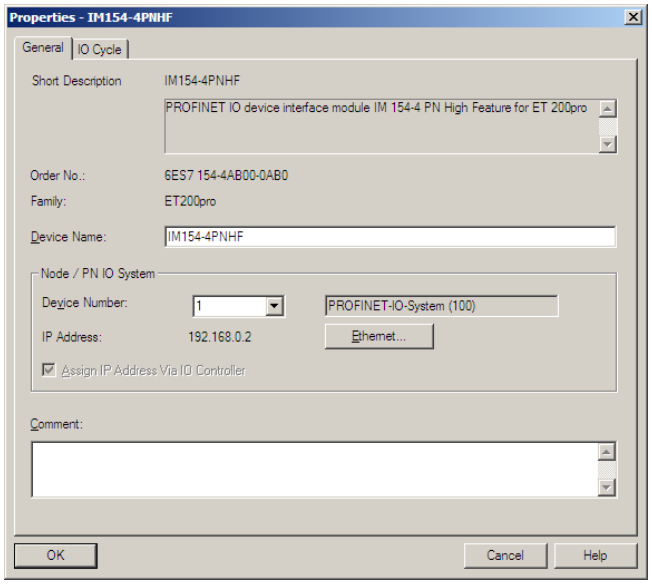


Figure 5-14 Specifying device names

The ET 200pro must then declare the name that has been selected. This can be performed in 2 different ways:

- Direct route --> The NameOfStation is written via PROFINET to the MMC of the IM in the ET 200pro:

  The prerequisite for this is a PC with PG functionality, which can establish an Ethernet connection with the ET 200pro. An MMC must also be inserted in the IM. The name is assigned in the SIMATIC Manager. To do this, select the station to which a name is to be assigned via the "Target system > Edit Ethernet nodes.." menu entries in the window that appears. Use the "Browse" button in the "Ethernet nodes" field to do this. With an online connection to the station, all of the stations in the network that can be accessed appear in the window that opens. The relevant ET 200pro is selected by means of the MAC address and confirmed with "OK". In the "Assign device name" field, a name can be edited and assigned using the "Assign name" button. The NameOfStation can then be found on the MMC of the IM in the ET 200pro.

- Indirect route --> Written to the memory card with "Prommer":

  If no PC with PG functionality is available, or an online connection to the ET 200pro cannot be established, the device name can also be written to the MMC of the IM with the "Prommer" device. To do this, insert the MMC of the IM in the Prommer. Enable the ET 200pro in the HW Config tool and go to "Store device name on memory card" in the "Target system" menu. The prerequisite for this is that the desired "Device name" has been edited previously via the "Edit > Object properties.." menu entries.

  After the name has been successfully written to the MMC of the IM, this can then be inserted in the IM of the ET 200pro station.

  The configuration should now appear as follows:

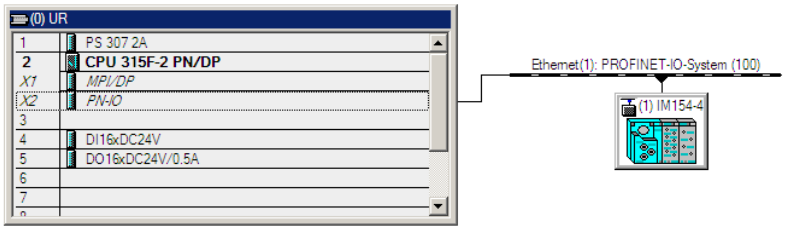


Figure 5-15 Configuration

Inserting a converter in an ET 200pro slot

From the hardware catalog select "FC 1.1/1.5 kW; standard telegram 1" and pull it onto the slot.

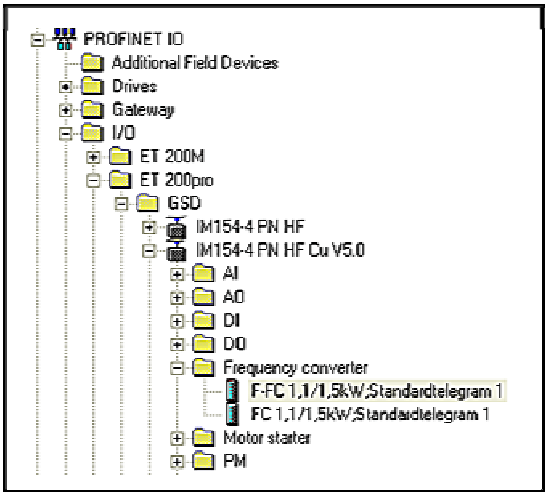


Figure 5-16 Selecting the frequency converter

Slot	Module	Order Number	I Address	Q address	Diagnostic address
0	IM154-4PNHF	6ES7 154-4AB10-0AB0			8187*
X2	IM154-4 PN HF Cu V5.0				8186*
X2	Port 1				8185*
X2	Port 2				8184*
1	PN-E DC24V	6ES7 148-4CA00-0AA0			8183*
2	FC 1,1/1,5kW;Standardte	6SL3 235-0TE21-1BB0	256...259	256...259	

Figure 5-17 Frequency converter in slot

Settings for the frequency converter

Double-clicking the frequency converter opens the property view with the following tabs:

- General
- Adresse
- Parameter.

Address/ID

Setting an address in the I/O map
The start address configured here is accepted in the user program as the "LADDR" input parameter for the blocks in the user program.

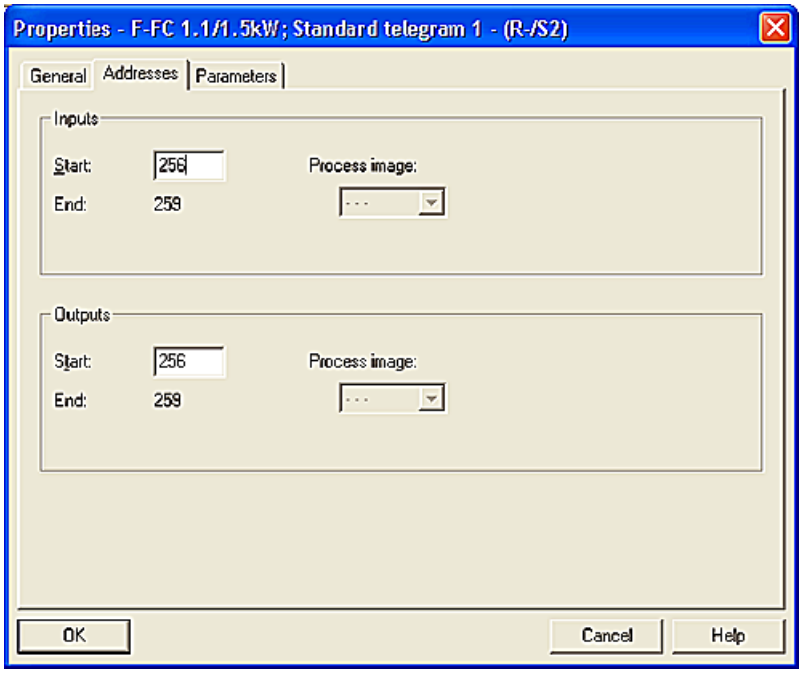


Figure 5-18 Setting the address in the I/O map

Note

The input and output address area of the frequency converter must be the same.

Parameter

The application ID provides a unique means of identification and is assigned by the user.

Note

If the same application ID is entered for several frequency converters, they can be used interchangeably. Frequency converters with the same application ID must be parameterized in the same way. Only frequency converters with the same parameters may be used interchangeably.

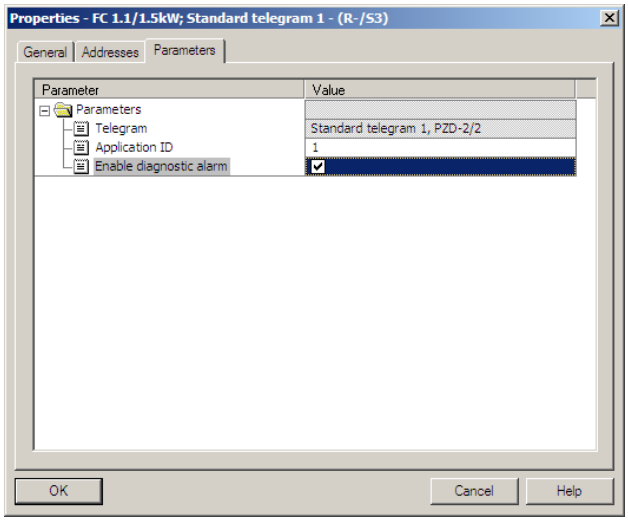


Figure 5-19 Parameter

Points to note when using the PROFIdrive profile

The alarm mode of the ET 200pro slave must be set to DPV1.

- Double-click the ET 200pro system
- Select the "Operating parameters" tab

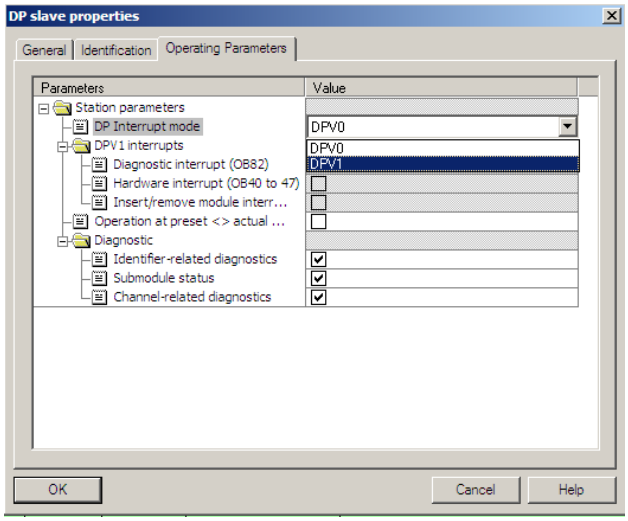


Figure 5-20 Operating parameters

- The diagnostic interrupt parameter of the frequency converter enables the S7 system diagnostics in PROFIdrive mode.
  - No diagnostic messages: 0
  - Diagnostic messages: 1.

Note

Enabled diagnostic messages require troubleshooting in the OB82 of the user program. (If there is no OB82 in the user program, the S7 enters the "STOP" state in the event of an error.)

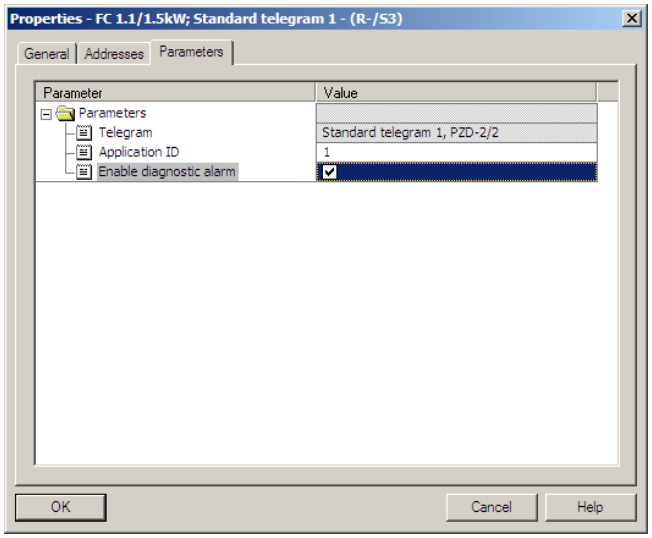


Figure 5-21 Setting the device-specific parameters

5.3.3 Creating a fail-safe configuration in SIMATIC Manager

Description

A configuration is carried out using the fail-safe I/O module F-Switch or F-RSM on PROFIBUS DP. The procedure with PROFINET IO is similar and will not be described separately.

Technical functions and the connections of the F-Switch and F-RSM are described respectively in the manual *ET 200pro Distributed I/O Devices - Fail-safe Modules* and in the manual *SIMATIC-ET 200pro Motor Starters*.

Requirements

The following preconditions exist for the configuring and parameterizing of ET 200pro fail-safe modules:

- STEP 7 V 5.3 SP3 or higher
- S7 Distributed Safety V5.4 or higher (F Configuration Pack V5.5 SP1 or higher)
- S7 F systems V5.2 SP2 or higher

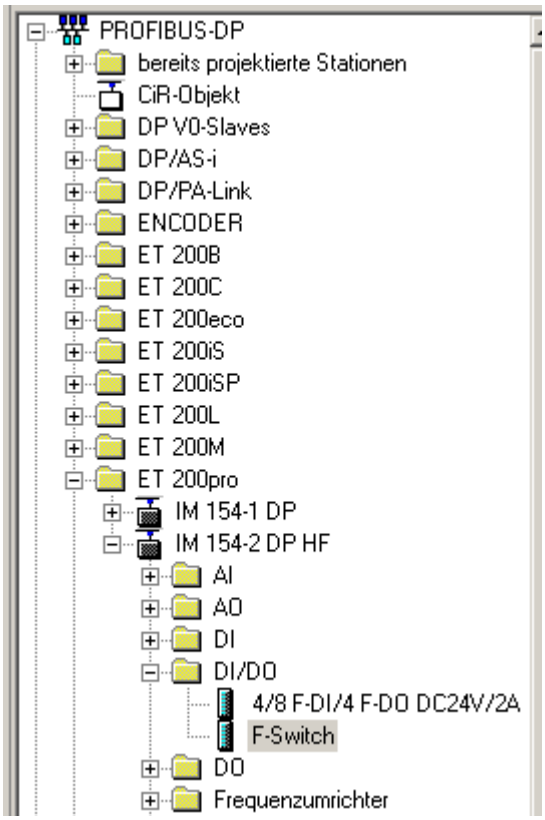
The F Configuration Pack can be downloaded from the Internet (www.siemens.com/automation/service&support).

Procedure

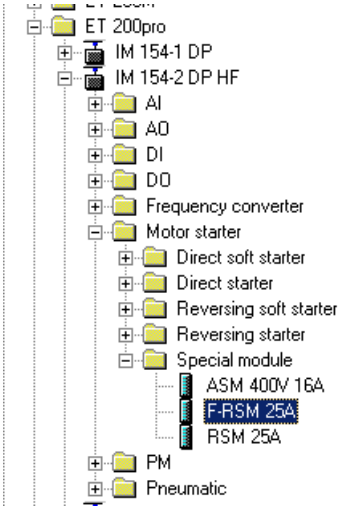
Once the IM154-2 HF has been positioned and parameterized in the master system, a module that can control the safety functions of the frequency converter using switch-off signals in the backplane bus is positioned to the left of the frequency converter.

A fail-safe module (F-Switch or F-RSM) is then plugged in.

Follow the usual procedure with STEP 7 HW Config to configure fail-safe modules (in the same way as standard ET 200pro modules).



Selection of F-Switch



Selection of F-RSM

The length of the process image of F-RSM is always one byte; only the start address must be set in the PI.

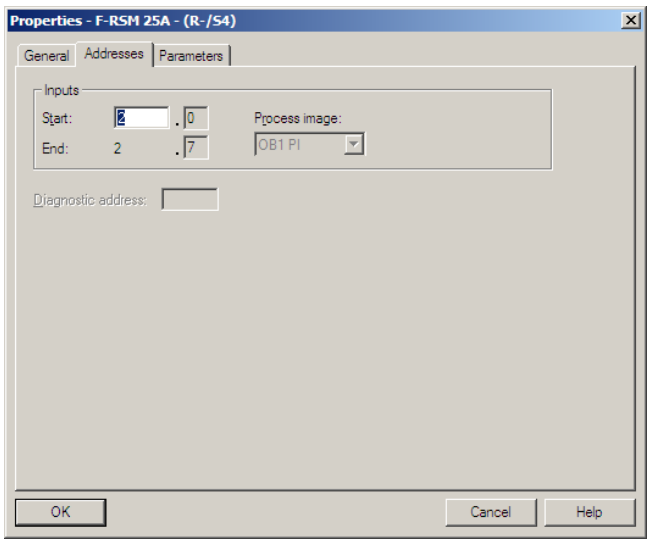


Figure 5-22 Defining the start address

Group diagnostics can be activated or deactivated.

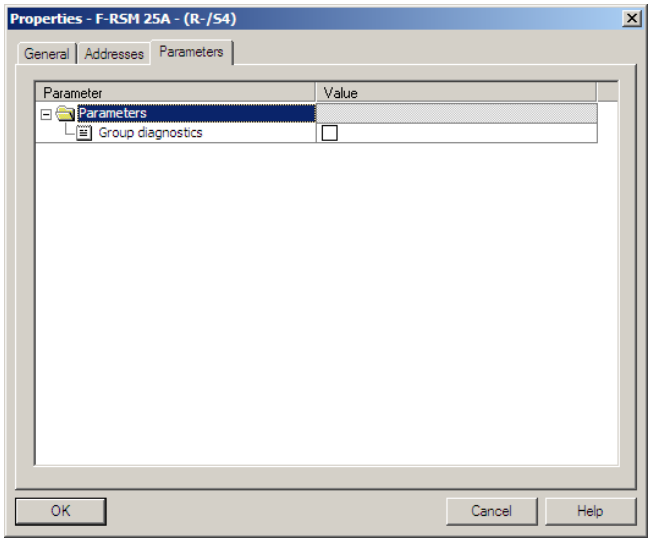


Figure 5-23 Specifying the diagnostics properties

You can use drag-and-drop to position the fail-safe frequency converter to the right of the F-Switch or F-RSM module. The configuration sequence is identical to the one used when generating a PROFIBUS configuration in the SIMATIC Manager.

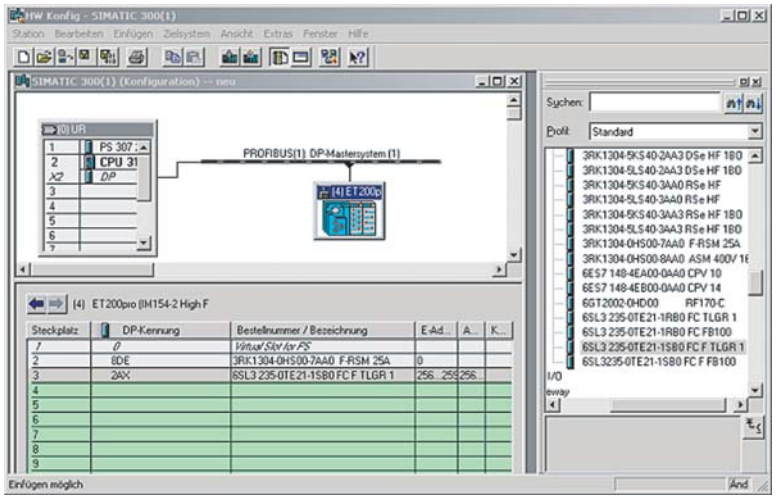


Figure 5-24 Configuring a frequency converter in a Safety Local environment

Parameterizing module properties

To parameterize fail-safe module properties, select the module in STEP 7 HW Config and select the menu command "Edit > Object properties".

Parameters are downloaded from the programming device to the F-CPU, where they are stored and then transferred to the fail-safe module.

Parameter description

The variable parameters of the fail-safe modules can be found in the manual entitled *ET 200pro Distributed I/O Devices - Fail-Safe Modules.*

PROFIsafe address and address assignment

The PS address is set using a 10-pin DIP switch on the left-hand side of the module housing. When carrying out parameterization using the PG, the user must specify the PS address selected for the module in binary code format. This corresponds to the DIP switch setting and the module PS address.

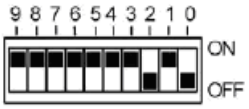


Figure 5-25 Setting the PROFIsafe address 1018 by way of example

Note

The switch positions 0000000000 and 1111111111 are not allowed!

Commissioning (hardware)

6

Introduction

Hardware commissioning involves the ET 200pro station and the drive components.

The following procedure describes by way of example the commissioning of a minimum configuration on PROFIBUS DP, with an S7 controller as the master and STARTER software directly on the optical interface of the frequency converter.

It is assumed that the user has the necessary knowledge of STARTER to create a drive configuration and to use the operating panel.

Preconditions

Table 6-1 Preconditions for commissioning

Actions	Reference
ET 200pro is mounted	Chap. *Assembling*
PROFIBUS address is set on interface module and IM is wired	Interface module manual
ET 200pro is configured	Chap. *Planning/Configuring*
Motor is connected	Chap. *Assembling*
Power supply to the DP master is ON	Manual for the DP master
The DP master is set to RUN mode	Manual for the DP master

6.1 Startup of ET 200pro

Procedure

Switch on the power supply for the ET 200pro station (electronics/encoder supply 1L+ for the ET 200pro).

Mode of operation

The illustration below represents the startup routine of the ET 200pro with a frequency converter.

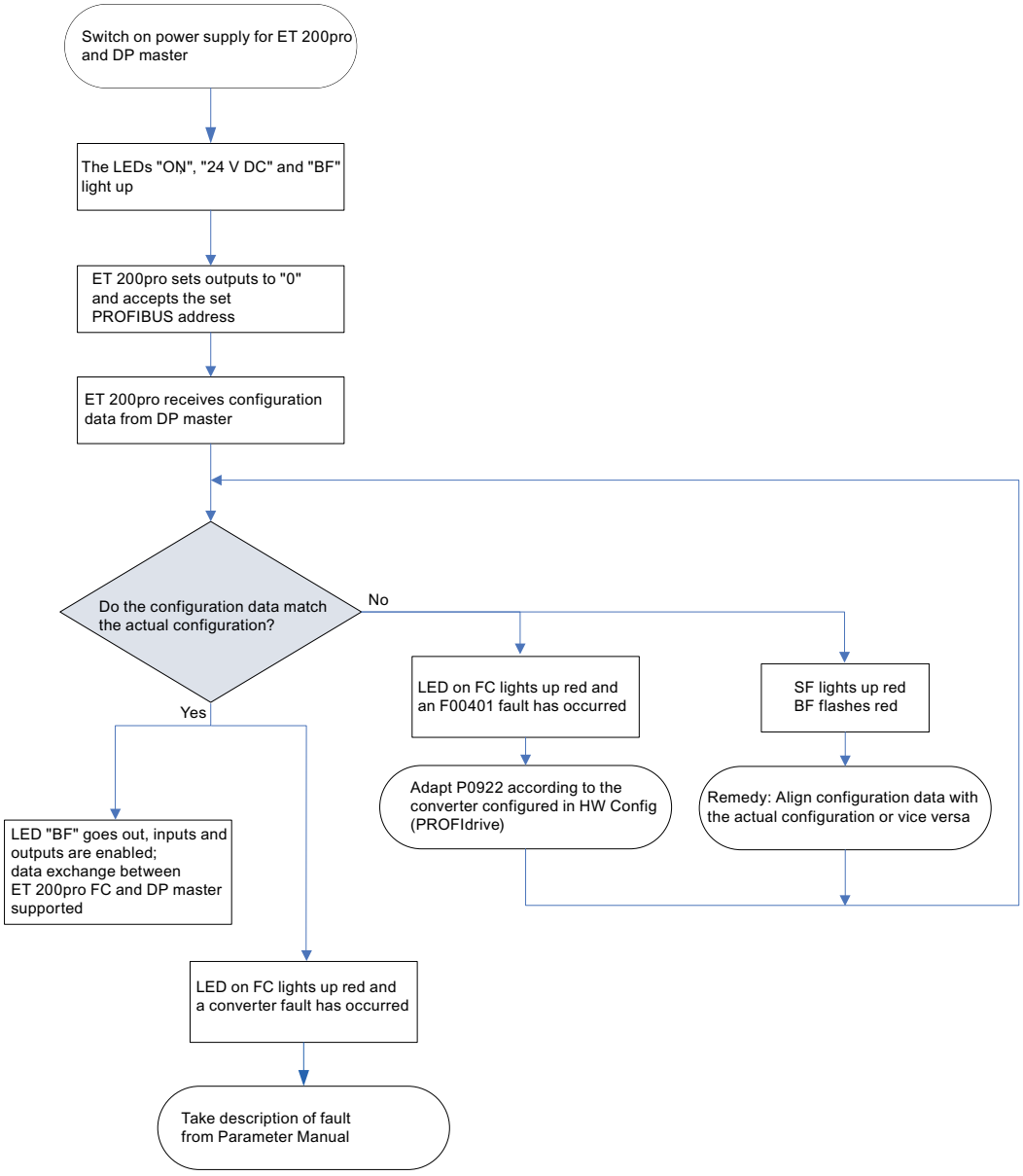

Switch on power supply for ET 200pro and DP master
The LEDs "ON", "24 V DC" and "BF" light up
ET 200pro sets outputs to "0" and accepts the set PROFIBUS address
ET 200pro receives configuration data from DP master
Do the configuration data match the actual configuration?
No
Yes
LED on FC lights up red and an F00401 fault has occurred
SF lights up red BF flashes red
Adapt P0922 according to the converter configured in HW Config (PROFIdrive)
Remedy: Align configuration data with the actual configuration or vice versa
LED "BF" goes out, inputs and outputs are enabled; data exchange between ET 200pro FC and DP master supported
LED on FC lights up red and a converter fault has occurred
Take description of fault from Parameter Manual

Figure 6-1 Starting up an ET 200pro with frequency converter

Note

The SF LED on the S7 will not necessarily light up if an error occurs on the ET 200pro FC. The S7 receives notification of an error only if diagnostic messages are enabled in the converter. This is done via parameterization in HW Config. If diagnostic messages are disabled, errors in the converter can only be read by means of the red LED on the converter.

6.2 Creating a drive configuration with STARTER

Procedure

- Connect STARTER to the to the RS232 interface of the frequency converter.
- Generate a drive configuration; in doing so, check the motor data and take into account the power derating in relation to the ambient temperature of the frequency converter.

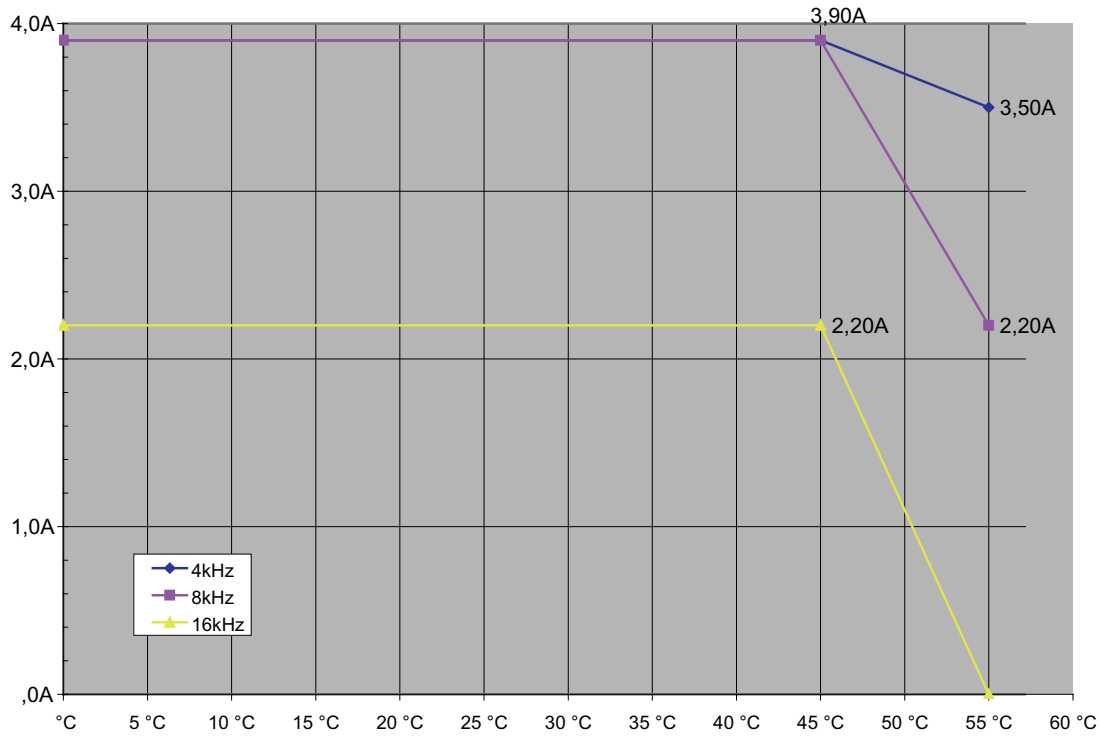
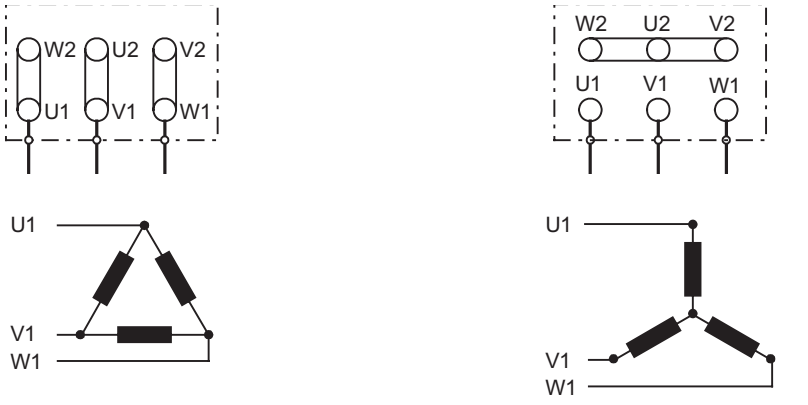


Figure 6-2 Power derating in relation to the ambient temperature

Checking the motor terminal box (IEC/NEMA motor)

For commissioning to be successful, it is important that the interconnection in the motor terminal box (see image below) corresponds to the entry for the rated motor voltage (P0304)/rated motor current (P0305).

IEC motor



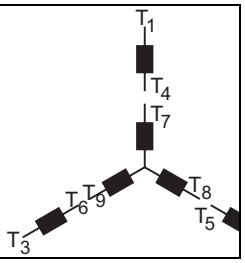
Delta connection

Star circuit configuration

E.g.: Voltage of 230 V (delta connection)/400 V (star connection)

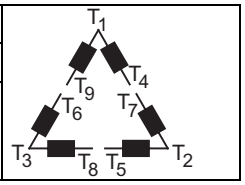
NEMA motor

Voltage	U	V	W	Connected to one another			Circuit
Low	T_1-T_7	T_2-T_8	T_3-T_9	T_4-T_5-T_6			Y Y
High	T_1	T_2	T_3	T_1-T_7	T_2-T_8	T_3-T_9	Y



E.g.: Voltage of 230 V YY (low)/460 V Y (high)

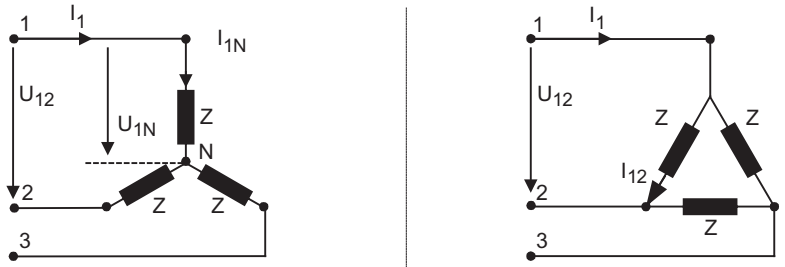
Voltage	U	V	W	Connected to one another			Circuit
Low	T_1-T6-T7	T_2-T_4-T_8	T_3-T_5-T_9	-			Δ Δ
High	T_1	T_2	T_3	T_4-T_7	T_5-T_8	T_6-T_9	Δ



Entering the type plate data

The following should be noted when entering the type plate data/ESB data:

- The phase-to-phase voltage (voltage U_{12} between external lines L1 and L2) and/or phase-to-phase current I_1 is always specified on the type plate.
- The rated motor voltage (P0304)/rated motor current (P0305) must always be entered according to the motor circuitry (delta/star).
- If the available rated motor data (P0304, P0305) are not consistent with the motor circuitry, they should be converted before they are entered.
- If ESB data (P0350, P0354, P0356, P0358, P0360) is available, this should be entered according to the motor circuitry. If the ESB data is not consistent with the motor circuitry, the ESB data should be converted before it is entered, in the same way as the data on the type plate (P0304, P0305).



$I_1 = I_2 = I_3$ $\quad I_{1,\Delta} = \frac{1}{\sqrt{3}} I_{1,Y}$ $\quad I_{12} = I_{23} = I_{31} = \frac{1}{\sqrt{3}} \cdot I_1$

$U_{12} = U_{23} = U_{31} = \sqrt{3} \cdot U_{1N}$ $\quad U_{12,\Delta} = \frac{1}{\sqrt{3}} U_{12,Y}$ $\quad U_{12} = U_{23} = U_{31}$

$\frac{U_{12}}{I_1} = 2 \cdot Z$ $\quad Z_{12,\Delta} = \frac{Z_{12,Y}}{3}$ $\quad \frac{U_{12}}{I_1} = \frac{2}{3} \cdot Z$

Figure 6-3 Star connection/Delta connection conversion

Note

The following formula can be used to check the accuracy of the motor type plate data:

$$P_N = \sqrt{3} \cdot U_{NY} \cdot I_{NY} \cdot \cos\varphi \cdot \eta \approx \sqrt{3} \cdot U_{N\Delta} \cdot I_{N\Delta} \cdot \cos\varphi \cdot \eta$$

mit	P_N	Motornennleistung	P0303
	U_{NY}, $U_{N\Delta}$	Motornennspannung (Stern / Dreieck)	P0304
	I_{NY}, $I_{N\Delta}$	Motornennstrom (Stern / Dreieck)	P0305
	$\cos\varphi$	Leistungsfaktor	P0308
	η	Wirkungsgrad	P0309

Commissioning and optimization (software) 7

7.1 Commissioning sequence

The sequence in which the software of a frequency converter in an ET 200 station is commissioned depends on how complex the drive application is, and on the automation structure.

The basic drive functions and the higher-level controller are commissioned first and are then specialized, optimized and the drive application generated.

The parameters and settings that are located during this process can be used for standard commissioning, if required.

Requirements

A prerequisite for software commissioning is functional hardware that has been commissioned according to the chapter entitled "Commissioning (hardware)".

A drive configuration has been generated for the converter and the motor has been commissioned with the factory settings.

Procedure

1. First commissioning and optimization
   - Frequency converter/motor combination
   - Drive application
   - Communication between the S7 CPU and frequency converter
   - Fail-safe functions
2. Standard commissioning

   Transferring the parameters and settings to other frequency converters

Table 7-1 First commissioning and optimization

Steps		Description	Tool
1	Commissioning and optimizing the frequency converter/motor combination	Basic parameterization has already been carried out when commissioning the hardware (quick commissioning). The motor type plate data and the frequency converter factory settings form the basis for this. Motor data are entered; Motor identification Motor data measurement Setting the V/f control (I-max controller, slip compensation, adaptation of the V/f characteristic) Setting the frequency control (pre-control, closed-loop PI controller) Torque limits	STARTER at the RS232 interface
2	Commissioning and optimizing the drive application	Frequency setpoint Frequency limitation (skip frequency bands, minimum and maximum limitation) Ramp function generator Motor temperature monitoring Brake control Flying restart Automatic restart Load torque monitoring	STARTER at the RS232 interface
3	Commissioning the communication between the S7 CPU and frequency converter: • PROFIdrive	Fieldbus parameters Telegram failure time Integrating the S7 program for the cyclic parameters into the S7 CPU	STEP 7 via fieldbus on the PLC STARTER at the RS232 interface
4	Commissioning fail-safe functions	Parameters Password protection	STARTER at the RS232 interface

Table 7-2 Standard commissioning

Steps	Description	Tool
Transferring the parameters and settings to other frequency converters	With STARTER	STARTER at the RS232 interface
	With MMC	MMC

7.2 Commissioning and optimization of the frequency converter and motor combination

Description

If there is still no matching parameter set for the drive, then quick commissioning including a motor data identification routine must be carried out - both for the closed-loop vector control and the V/f control. A PC with the STARTER commissioning software can be used for the quick commissioning.

Once the quick commissioning has been completed, the frequency converter can put into operation. Before starting the quick commissioning, the following data must be queried, changed or entered:

- Enter the line frequency
- Enter the rating plate data
- Min./max. frequency or ramp-up/ramp-down time
- Control mode
- Motor data acquisition

7.2.1 General

The frequency converter can be adapted to different applications by changing the parameter values.

Upload and download

Upload is understood to mean the saving of parameters from the EEPROM of a frequency converter to a PC (using STARTER) or to an MMC. Download is understood to mean the transferring of a parameter set saved on a PC or an MMC into the RAM or EEPROM memory of a frequency converter.

The commissioning procedure using STARTER is interactive and will not, therefore, be described in more detail here.

STARTER can be connected locally to the frequency converter, or can access the fieldbus via the frequency converter.

Table 7-3 STARTER connection options

Type	USS to RS232	Fieldbus
PC connected to frequency converter via	RS232 interface cable	Fieldbus cable
Restrictions	Peer-to-peer	Routing via SIMATIC CPU not possible

STARTER projects

STARTER can be used to either create a new project or open an existing one. To create a new project in STARTER, any of the following procedures can be used:

- Find frequency converter
- Wizard
- Select frequency converter

When an existing project is opened or a new one created, STARTER will be in offline mode. To go online, press the ("Connect to target system") button.

Changing parameters with STARTER

Parameters can be changed online or offline (but preferably online). Parameter changes made online are stored in the RAM of the frequency converter. Transferring from RAM to the EEPROM can be triggered manually by pressing the ("Copy RAM to ROM") button. If the content of the RAM and EEPROM are different when the user closes STARTER, he/she will be asked if he/she wishes to transfer the data from the RAM to the EEPROM.

Note

The storage method can be changed by means of P0014:

- P0014=0: Parameter changes stored in RAM (default)
- P0014=1: Parameter changes stored in EEPROM.

Parameter sets that have been changed offline can be transferred to the frequency converter using the download function ("Download project to target system").

CAUTION
Parameters for safety functions can only be changed in online mode. Parameters for safety functions are not downloaded when parameters are downloaded using STARTER.

7.2.2 Calculating the motor and controller data

The internal motor and controller data are calculated using the parameter P0340, or indirectly with the help of the parameter P3900 or P1910. The function of the parameter P0340 can be used, for example, if the data of the replacement circuit or the values of the moments of inertia are known.

Table 7-4 Settings for P0340

P0340	Meaning
0	No calculation
1	Complete parameterization
2	Calculation of the replacement circuit data
3	Calculation of V/f and the closed-loop vector control
4	Calculation of the controller settings

For complete parameterization (P0340=1), not only the motor and controller parameters are assigned in advance but also the parameters which are related to the rated motor data (e.g. torque limit values and reference quantities for interface signals). The List Manual contains a full list of all parameters depending on P0340. For calculation of the motor and controller data with P0340 there are various scenarios which can be called up as a function of the known data.

7.2.3 Motor Data Identification

Description

The Inverter has a measuring technique which is used to determine the motor parameters:

Equivalent circuit diagram (ECD)	→	P1900 = 2
Measures Equivalent circuit diagram (ECD) + Magnetizing characteristic (includes P1900 = 2)	→	P1900 = 3

For control-related reasons, it is essential that the motor data identification is performed. Without performing the motor data identification it is only possible to estimate ECD data using information from the motor rating plate. For example, the stator resistance is extremely important for the stability of the closed-loop Vector control and for the voltage boost of the V/f characteristic. The motor data identification routine should be executed, especially if long feeder cables or if third-party motors are being used.

If the motor data identification routine is being started for the first time, then the following data is determined, starting from the rating plate data (rated [nominal] data) with P1900 = 2:

- ECD data
- Motor cable resistance
- IGBT on-state voltage and compensation of IGBT gating dead times.

The rating plate data represents the initialization values for the identification. This is the reason that it is necessary to have the correct input from the rating plate data when determining the data specified above.

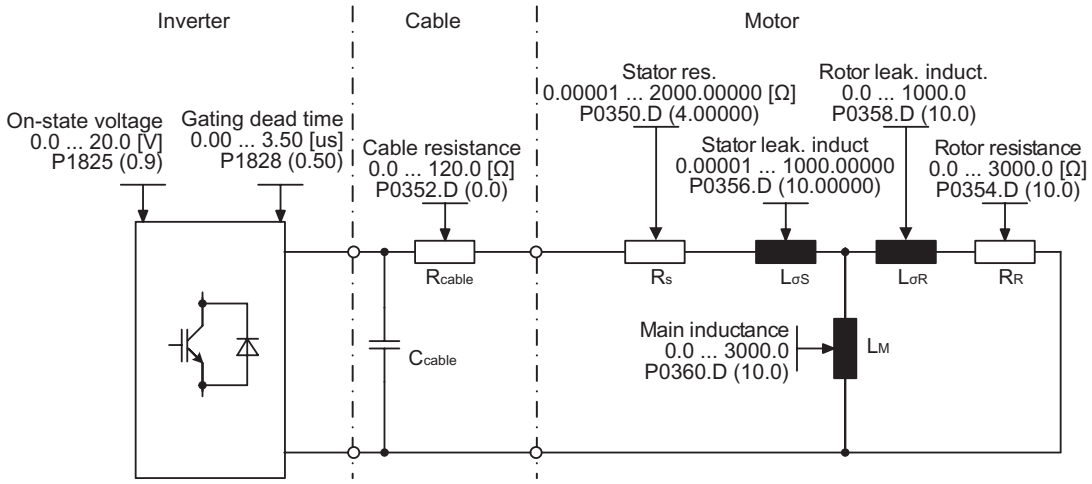


Figure 7-1 Equivalent circuit diagram (ECD)

In addition to the ECD data, the motor magnetizing characteristic (see the figure above) can be determined using the motor data identification (P1900 = 3). If the motor-inverter combination is operated in the field-weakening range (which is above the nominal frequency of the motor), then this characteristic should be determined, especially when Vector control is being used. As a result of this magnetizing characteristic, the Inverter can, in the field-weakening range, accurately calculate the current which is generated in the field and in-turn achieve a higher torque accuracy.

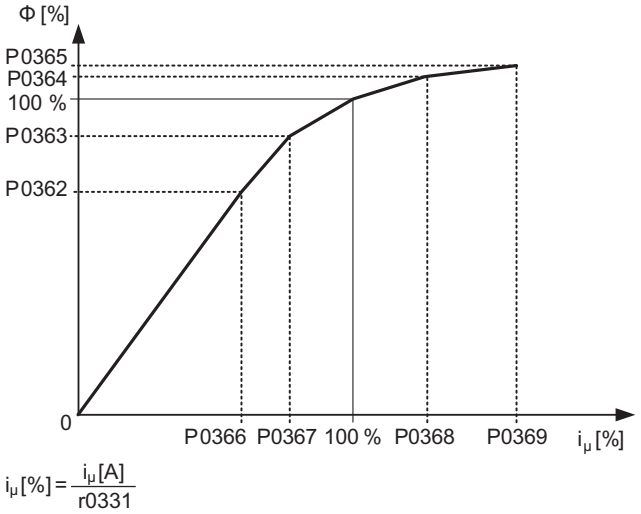


Figure 7-2 Magnetizing characteristic

The motor data identification is carried-out with the motor at a standstill and it takes, including the data calculation per selection (P1900 = 2 or 3), between 20 seconds and 4 minutes to complete. While the motor data identification is active A0541 is displayed. The identification time depends on the motor and increases with its size (this takes approx. 4 min. for a 200 kW motor).

The motor data identification routine must be carried-out with the motor in the **cold** condition so that the motor resistance values saved can be assigned to the parameter of the ambient temperature P0625. Only then is the correct temperature adaptation of the resistances possible during operation.

The motor data identification routine operates with the results of the "Complete parameterization" P0340 = 1 or the motor equivalent diagram data which was last saved. The results become increasingly better the more times that the identification routine is executed (up to 3 times).

⚠WARNING

It is not permissible to carry-out the motor identification routine for loads which are potentially hazardous (e.g. suspended loads for crane applications). Before starting the motor data identification routine, the potentially hazardous load must be secured (e.g. by lowering the load to the floor or clamping the load using the motor holding brake).

When starting the motor data identification routine, the rotor can move into a preferred position. This is more significant for larger motors.

Note

The equivalent circuit data (P0350, P0354, P0356, P0358, P0360) and the motor cable resistance (P0352) are entered as phase values.

During the motor identification routine, the sum of the stator resistance (P0350) and the motor cable resistance (P0352) are determined. To get a correct stator resistance the cable resistance has to be set before the motor identification has been started.

If the motor cable resistance is known, it should be entered into parameter P0352 before the motor data identification. The value of P0350 then will be changed in dependenccy of P0352 and is more precisely as the calculated value.

It is not necessary to lock the motor rotor for the motor data identification routine. However, if it is possible to lock the motor rotor during the identification routine (i.e. by closing the motor holding brake), then this should be used to determine the equivalent circuit diagram data.

The following formula can be applied to check the correctness of the motor rating plate data:

$P_N = \sqrt{3} * V_{NY} * I_{NY} * \cos\phi * \eta \approx \sqrt{3} * V_{N\Delta} * I_{N\Delta} * \cos\phi * \eta$

Where:

P_N	rated motor power
$V_{N\,Y}$, $V_{N\,\Delta}$	rated motor voltage (star/delta)
$I_{N\,Y}$, $I_{N\,\Delta}$	rated motor current (star/delta)
cosϕ	power factor
η	efficiency

Before starting the motor identification, the correct ambient temp value should be entered in P0625 (default 20°C).

If Problems occur during the identification run, for example, the current controller oscillates, then the rating plate data should be re-checked and an approximately correct magnetizing current P0320 entered. The motor data identification routine should then be re-started by calling P1900 = 2 or P1900 = 3.

A step-by-step description is given in section "Quick Commissioning".

Parameter settings

⚠WARNING

The motor data identification routine MUST not be used for loads which are potentially hazardous (for example, suspended loads for crane applications). Before the motor data identification routine is started, the potentially hazardous load must be carefully secured (for example, by lowering the load to the floor or by clamping the load using the motor holding brake).

Parameter	Description
P0625 = …	**Ambient motor temperature** (entered in °C) The motor ambient temperature is entered at the instant that motor data is being determined (factory setting: **20 °C**). The difference between the motor temperature and the motor ambient temperature P0625 must lie in the tolerance range of approx. ± 5 °C.
If not the motor must be allowed to cool down.	
P0010 = 0	**Commissioning parameter filter*** Check if P0010 = 0 (Ready)
P1900 = 3	**Select motor data identification*** 0: Disabled (default) 2: Identification of all parameters in standstill. 3: Identification of all parameters in standstill including saturation curve
ON command	**Start motor data identification** Once P1900 ≠ 0, alarm A0541 is generated that states, the next ON command will initiate the motor data identification. When the ON Command is given, current flows through the motor and the rotor aligns itself. Note: When motor data identification is complete A0541 will be cleared and P1900 will be set to zero.
OFF1	In order to set the inverter into a defined state, an OFF1 command must be issued before the next step. With the OFF1 command the motor data identification is finished.

7.3 Commissioning and optimization of the drive application

After the motor and converter combination is commissioned by quick commissioning, parameters must be adapted and set to suit the requirements of the specific application.

Note

According to the factory setting, parameter changes are saved in the volatile memory (RAM) of the converter. One of the following options can be used for saving the changes to EEPROM:

- Set P0014 = 1: all changes are then saved immediately to EEPROM
- Trigger transfer from RAM to EEPROM via P0971 = 1
  or via the STARTER button.

The duration of the data transfer depends on the number of parameters changed. In some cases it can take up to 3 minutes.

When using STARTER, the transfer is indicated by a progress bar. A dialog field announces when transfer is successful.

The *List Manual* contains detailed parameter descriptions.

General settings

Parameters	**Description** (parameter name and factory setting in bold)	**Setting**
P0290 = 2	**Converter overload behavior** Specifies the converter's response to internal overheating. 0: Reduce output frequency 1: Shut down (F00004) 2: Reduce pulse frequency and output frequency 3: Reduce pulse frequency, then shut down (F00004)	
P0335 = 0	**Motor cooling** (enter the motor's cooling system) **0: Self-cooling using fan attached to the motor, mounted on the shaft** 1: Separate cooling by means of a separately-driven cooling fan 2: Self-cooling and internal fan 3: Separate cooling and internal fan	

Temperature encoder

Parameters	**Description** (parameters and factory settings in bold)	**Setting**
P0601 = 0 or P0601 = …	**Motor temperature encoder** 0: No encoder (→ P0610) 1: PTC thermistor (→ P0604) 2: KTY84 (→ P0604)	
P0604 = 130°	**Motor temperature limit** Enter the alarm limit value of the motor overtemperature protection. The shutdown temperature (limit) is the value at which the converter will either shut down or I_{max} will be reduced (P0610); this always happens at 10% above the alarm limit value.	
P0610 = 2	**I2t temperature behavior of the motor** (This defines the behavior of the motor if the temperature has reached the alarm limit value.) 0: No response, alarm only 1: Alarm and reduction of Imax (this results in a reduced output frequency) 2: Alarm and shutdown (F00011)	

Temperature calculation without encoder

Temperature calculation without a temperature encoder is possible in all operating modes. In vector mode the current temperature is determined automatically when the converter is switched on and the motor is hot. In V/f mode the motor temperature is set to an average value in this case.

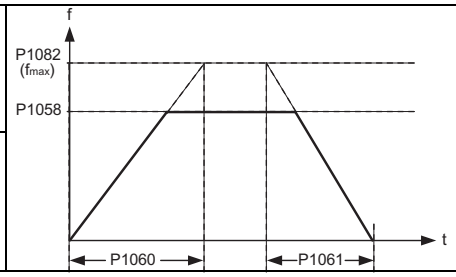
Parameters	**Description** (parameters and factory settings in bold)	**Setting**
P0621 = 1	**Motor temperature measurement after restarting** 0: No measurement. 1: Temperature measurement upon first power-up after an OFF/ON switching operation? 2: Temperature measurement after each power-up.	
P0622 = …	**Motor remagnetizing time for temperature measurement after ON signal** Length of a measuring cycle time for motor temperature measurement after ON signal Several measuring cycles are required to increase accuracy. This measuring cycle is pre-assigned the magnetizing time from the Mot ID (r0384)t.	

Setting the frequency setpoint

Parameters	**Description** (parameter name and factory setting in bold)	**Setting**
P1000 = …	Selecting the frequency setpoint 0: No master setpoint 6: **Fieldbus** (P2050 … P02091)	

JOG frequency

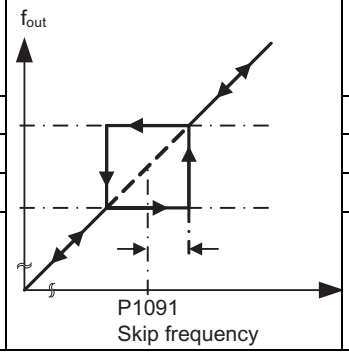
Parameter	Description	Setting
P1057 = 1	**JOG Enable** P1057 = 0 JOG-function disabled P1057 = 1 JOG-function enabled (default)	
P1058 = 5	**JOG frequency right** Frequency in Hz when the motor is being jogged in the clockwise direction.	
P1059 = 5	**JOG frequency left** Frequency in Hz when the motor is being jogged in the counter-clockwise direction.	
P1060 = 45	**JOG ramp-up time** Ramp-up time in seconds from 0 to the maximum frequency (P1082). The JOG ramp-up is limited by P1058 or P1059.	
P1061 = 50	**JOG ramp-down time** Ramp-down time in seconds from the maximum frequency (P1082) to 0.	



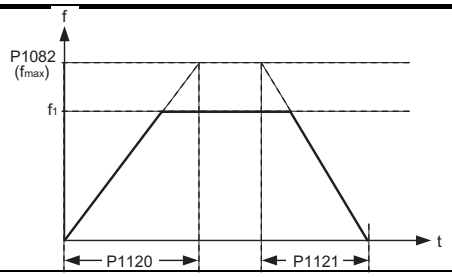
Additional setpoints

Parameters	Description (parameter name and factory setting in bold)	Setting
P1074 = 1.0	**BI: Disable additional setpoint**	
P1075 = 775	**CI: Additional setpoint** Specifies the source of the additional setpoint, which is added to the main setpoint.	
P1076 = 1.0	**CI: Additional setpoint scaling** Defines the source for scaling the additional setpoint. **General settings**: 1: Scaling 1.0 (100%) 755: Analog input setpoint 1024: Fixed frequency setpoint 1050: MOP setpoint	

Skip Frequency

Parameter	Description		Setting
P1091 = 7.5	**Skip frequency 1** (entered in Hz) Avoids mechanical resonance effects and suppresses (skips) frequencies in the range around the skip frequency ± P1101 (skip frequency bandwidth).		
P1092 = 0.0	**Skip frequency 2**		
P1093 = 0.0	**Skip frequency 3**		
P1094 = 0.0	**Skip frequency 4**		
P1101 = 1.0	**Skip frequency bandwidth** (entered in Hz)		

Ramp times

Parameter	Description		Setting
P1120 = 10	**Ramp-up time** Enter the acceleration time in seconds.		
P1121 = 10	**Ramp-down time** Enter the deceleration time in seconds.		

Rounding

Parameter	Description		Setting
P1130 = 5.0	**Ramp-up initial rounding time** (in seconds)	The rounding times are recommended, to avoid abrupt responses and so to minimize stress to the mechanical system. The ramp-up and ramp-down times are extended by the component of the rounding ramps.	
P1131 = 5.0	**Ramp-up final rounding time** (in seconds)		
P1132 = 5.0	**Ramp-down initial rounding time** (in seconds)		
P1133 = 5.0	**Ramp-down final rounding time** (in seconds)		
P1134 = 0	**Rounding type** **0: continuous smoothing** (jerk-free) 1: Discontinuous smoothing **NOTE**: for discontinuous rounding (P1134 = 1), after the setpoint is reduced or an OFF1 command, the final rounding at ramp-up (P1131) and the initial rounding at ramp-down (P1132) are not executed.		

Parameters which must be set before ending the application settings

The following parameters must be configured for every application.

Parameters	Description (parameter name and factory setting (if non-variable) in bold print)	Setting
P1800 = 4	**Pulse frequency** (kHz) The pulse frequency can be changed in steps of 2 kHz. The range extends from 2 kHz to 16 kHz. The full output current of the converter at 55 °C is 4 kHz. The highest output frequency is limited by the pulse frequency. With a pulse frequency of 2 kHz, operation up to 133 Hz is possible. If a higher output frequency is required, the pulse frequency should also be increased (10 kHz pulse frequency - maximum output frequency of 650 Hz). If no low-noise operation is required, then the converter losses and the high-frequency interference transmitted by the converter can be reduced by selecting a lower pulse frequency.	
P2000 = 50	**Reference frequency** (Hz) The reference frequency in Hertz corresponds to a value of 100 %. This setting should be changed if a maximum frequency greater than 50 Hz is required. Comments: This scaling has an effect on the maximum frequency of the analog setpoints. Fixed frequencies and standardization processes of the motor potentiometer are related to 100 %.	
P2001 = 1000	**Reference voltage** (V) The reference voltage in Volt (output voltage) corresponds to a value of 100 %. Comments: This setting should only be changed if the power must be output with a different scaling.	
P2002 = ?	**Reference current** (A) The reference current in Ampere (output current) corresponds to a value of 100 %. The factory setting equals 200 % of the rated motor current (P0305). Comments: This setting should only be changed if the current must be output with a different scaling.	
P2003 = ?	**Reference torque** (Nm) The reference torque in Newton meter corresponds to a value of 100 %. The factory setting equals 200 % of the rated motor torque which is determined from the motor data for a constant motor torque. Comments: This setting should only be changed if the torque must be output with a different scaling.	
P2004 = ?	**Reference power** (kW or hp) The reference power in kW or hp corresponds to a value of 100 %. The factory setting is 200 % of the rated motor torque at constant motor torque. This setting should only be changed if the power must be output with a different scaling.	

Ending the application settings

Parameters	Description (parameter name and factory setting (if non-variable) in bold print)	Setting
P0971 = 1	**Adopting data from RAM into EEPROM** **0: Inhibited** 1: All parameter changes are transferred from RAM into EEPROM, i.e. the data are not lost if there is a power failure.	

7.4 Commissioning of communication between the S7 CPU and the frequency converter

7.4.1 Parameter settings for communication

The frequency converter is operated by means of PROFIdrive profile.

Table 7-5 Standard telegram 1

Telegram	Function in the drive	PZD1	PZD2	PZD3	PZD4
1 (PROFIdrive)	Speed control 2 words	STW1	NSOLL_A	← Receive telegram from fieldbus → Send telegram to fieldbus	
		ZSW1	NIST_A		

STW 1	Control word 1
ZSW 1	Status word 1
NSET_A (P1070)	Speed setpoint A (16-bit)
NIST_A (r0021)	Speed setpoint A (16-bit)

Fieldbus parameter

The following parameters must be set in order to put the fieldbus interface into operation:

Table 7-6 Fieldbus parameters

Parameter	Contents
P0700	Fast selection of command source
P1000	Fast selection of frequency setpoint
P2051	Actual values for process data (BICO)
P2040	Failure time of process data telegram
P0927	Parameter change source

P0700 and P1000 fast selection

The control word and setpoint sources can be selected quickly in parameters P0700 (Select command source) and P1000 (Select frequency setpoint).

r2050 and P2051 BICO

- If process data is interconnected by means of binectors/connectors, much greater flexibility is offered.
- The precise connection of setpoints and actual values from/to the fieldbus interface is parameterized in r2050 and P2051.

- The table below shows the parameters used to transfer process data in PROFIdrive mode.

Table 7-7 Parameters for flexibly interconnecting process data in the PROFIdrive profile

Telegram	PZD1 STW/ZSW	PZD2 HSW/HIW
Connection values for setpoints, master to converter	r2050.00	r2050.01
Connection parameters for actual values, converter to master	P2051.00	P2051.01

Note

r2050 also acts as a display parameter, by means of which the setpoint received from the fieldbus can be checked.

CAUTION

The watchdog function must not be disabled. If this monitoring function is disabled and a fault occurs at the fieldbus interface, the converter cannot detect a fault condition and, therefore, continues to run even in the event of a fault.

Process data monitoring

The telegram failure time is monitored in the converter using parameter P2040.

P2040 telegram failure time

Parameter P2040 specifies the time after which a fault code (F0070) is generated if no telegram is received via the fieldbus.

- P2040 = 0 means: No monitoring
- P2040 > 0 means: The time in milliseconds after which a fault condition is generated if no setpoint telegram has been received.

CAUTION

Faults can only trigger a shutdown if both monitoring functions are active.

If communication is taking place via the fieldbus, parameter P2040 should also be set to a value > 0. This enables/disables the process data monitoring function if the watchdog function is used on its own. The monitoring time corresponds to the watchdog time setting value, plus the time set in P2040.

Note

Process data for which the complete control word (PZD1) is set to zero are not transferred to the converter via the fieldbus. Result: Fault F00070 may occur.

P0927 parameter change source

Bit	Description	Value	
0	Fieldbus	0: No	1: Yes
2	Local interface	0: No	1: Yes

The factory setting for all bits is 1, i.e., the parameters can be changed from all sources.

7.4.2 Process data transfer in the PROFIdrive profile

7.4.2.1 Control and status words

Control word 1 (STW1)

(Bits 0 to 10 according to PROFIdrive profile; bits 11 to 15 specifically for SIMATIC ET 200S FC and ET 200pro FC).

Table 7-8 Preassignment, control word 1

Bit	Value	Meaning	Remarks
0	1	ON	Puts the frequency converter into the "Ready to run" state. The direction of rotation must be specified with bit 11.
	0	OFF1	Shutdown, deceleration of ramp function generator ramp, pulse tripping when f < f_{min}.
1	1	Do not run down to standstill	All "Run down to standstill" (OFF2) commands are canceled.
	0	Run down to standstill (OFF2)	Immediate pulse tripping; drive runs down to a standstill.
2	1	No rapid standstill	All "Rapid standstill" (OFF3) commands are canceled.
	0	Rapid standstill (OFF3)	Rapid stop: Shut down with the quickest possible delay rate.
3	1	Enable operation	CL-control and frequency converter pulses are enabled.
	0	Disable operation	CL-control and frequency converter pulses are disabled.
4	1	Enable ramp function generator	--
	0	Reset ramp function generator	Ramp function generator output set to 0 (quickest possible deceleration); frequency converter remains in ON state.
5	1	Enable ramp function generator	--
	0	"Freeze" ramp function generator	The setpoint currently provided by the ramp function generator is "frozen".

Bit	Value	Meaning	Remarks
6	1	Enable setpoint	The value selected on the ramp function generator input is enabled.
	0	Inhibit setpoint	The value selected on the ramp function generator input is set to 0 (zero).
7	1	Acknowledge error	Error acknowledged with a positive pulse edge; frequency converter then switches to the "Begin interlocking" state.
	0	Not relevant	--
8	1	JOG 1 ON	The drive runs up to the setpoint for jog mode as quickly as possible (direction of rotation: clockwise).
	0	JOG 1 OFF	Drive brakes as quickly as possible.
9	1	JOG 2 ON	The drive runs up to the setpoint for jog mode as quickly as possible (direction of rotation: counter-clockwise).
	0	JOG 2 OFF	Drive brakes as quickly as possible.
10	1	Open-loop control with PLC	Open-loop control via interface; process data valid
	0	No open-loop control with PLC	Process data invalid except for "sign of life"
11	1	Setpoint inversion	Motor runs counter-clockwise as a response to a positive setpoint.
	0	No setpoint inversion	Motor runs clockwise as a response to a positive setpoint.
12	-	Not used	--
13	-	Not used	--
14	-	Not used	--
15	1	Command data set bit 0	--

Status word 1 (ZSW1)

(Bits 0 to 10 according to PROFIdrive profile; bits 11 to 15 specifically for SINAMICS frequency converters).

Table 7-9 Preassignment, status word 1

Bit	Value	Meaning	Remarks
0	1	Ready to start	Power supply switched on; electronics initialized; pulses disabled.
	0	Not ready to start	--
1	1	Ready	Frequency converter is switched on (ON command is present); no fault enabled; frequency converter can run as soon as the "Enable operation" command is issued. See control word 1, bit 0
	0	Not ready to start	--
2	1	Operation enabled	Drive follows setpoint. See control word 1, bit 3
	0	Operation inhibited	--
3	1	Fault present	Drive is faulty. A fault is present in the drive; it is, therefore, not operating and will switch back to the "Begin start interlock" state once the fault has been successfully eliminated and acknowledged.
	0	No fault	--
4	1	"Run down to standstill" not enabled	--
	0	"Run down to standstill" enabled	"Run down to standstill" (OFF2) command present.
5	1	"Rapid stop" not enabled	--
	0	"Rapid stop" enabled	"Rapid stop" (OFF3) command present.
6	1	Switch-on disabled	The drive is then only transferred to the "Switched on" state when the "Do not run down to standstill" AND "No rapid stop" commands, followed by "ON", are issued.
	0	Switch-on not disabled	
7	1	Warning present	Drive still in operation; warning in service/maintenance parameters; no acknowledgement; see interrupt parameter r2110.
	0	No warning	No warning is present, or the warning has disappeared.
8	1	Speed deviation within tolerance range	Setpoint/actual value deviation within tolerance range.
	0	Speed deviation outside of tolerance range	--
9	1	Master control requested	The automation system is requested to assume control.
	0	No control requested	The master is not currently the master control.
10	1	Maximum frequency reached or exceeded	Frequency converter output frequency is greater than or equal to the maximum frequency.

Bit	Value	Meaning	Remarks
	0	Maximum frequency not reached	--
11	1	--	--
	0	Warning: Motor current/torque limit reached	--
12	1	Motor holding brake enabled	Signal can be used to control a holding brake.
	0	--	--
13	1	--	Motor data display overload status.
	0	Motor overload	--
14	1	Clockwise rotation	--
	0	Counter-clockwise rotation	--
15	1	--	--
	0	Converter overload	For example, current or temperature

7.4.2.2 Examples

Writing PROFIdrive process data

In this example, the control word STW1 and the setpoint frequency are written in PROFIdrive mode. The inputs E0.0 and E0.6 are linked to the Start/Stop bit or to the Acknowledge Fault bit of the control word STW1.

The process data are written in the cyclical time slice of the S7 (e.g. OB1) at logical address 256 of the frequency converter.

Note

Please note that the way cyclic data are interpreted depends on how the frequency converter is parameterized (P2050, P0922).

Four bytes of process data are always transferred to the central control unit consistently. Use of the SFC14 and SFC15 is not necessary.

```
Network 1 : Title:
STW1: 0x47E
FREQ: 0x2500

      L     W#16#47E
      T     MW     1
      L     W#16#2500
      T     MW     3

Network 2 : Title:
Acknowledge fault

      U     E      0.6
      =     M      2.7

Network 3 : Title:
Start/Stop

      U     E      0.0
      =     M      2.0

Network 4 : Title:
Write process data

      L     MW     1
      T     PAW  256
      L     MW     3
      T     PAW  258
```

Figure 7-3 Writing PROFIdrive process data

Reading PROFIdrive process data

In this example, status word 1 and the instantaneous frequency are read in PROFIdrive mode. The process data are read in the cyclical time slice of the S7 (e.g. OB1) from logical address 256 of the frequency converter.

```
Network 5 : Title:
Read process data

      L     PEW  256
      T     MW     5
      L     PEW  258
      T     MW     7
```

Figure 7-4 Reading PROFIdrive process data

Note

Please note that the way cyclic data are interpreted depends on how the frequency converter is parameterized (P2051, P0922).

7.4.3 Parameter transfer in the PROFIdrive profile

7.4.3.1 Block call

Acyclic data transfer can take place parallel to cyclic data transfer. The acyclic data transfer mode allows:

- Large quantities of user data (on PROFIBUS up to 240 bytes) to be exchanged
- Access through other PROFINET hosts (Class 2 masters, or in the case of PROFINET IO by other IO controllers, e.g. commissioning tools) is possible.

Use of the expanded bus functions

There are suitable channels available in the frequency converters for the different masters and IO controllers and for the different data transmission rates:

- Acyclic data exchange with the same master class of Class 1 or the same IO controller: Use of the READ and WRITE functions. In this case, the content of the transferred data block corresponds to the structure of the non-cyclic parameter channel in accordance with the PROFIdrive profile, V4.0 (with data block 47 (DS47)).
- Acyclic data exchange with the help of a SIEMENS startup tool (master of Class 2 or supervisor) (e.g. STARTER). The startup tool can acyclically access parameters and process data in the frequency converter.
- Acyclic data exchange with a SIMATIC HMI (Human Machine Interface) (second master of Class 2 or second supervisor). The SIMATIC HMI can acyclically access parameters in the frequency converter.
- Instead of a SIEMENS commissioning tool or a SIMATIC HMI it is also possible for an external master (master of Class 2) or an external supervisor, as defined in the acyclic parameter channel according to the PROFIdrive profile, Version 4.0 (with DS47), to access the frequency converter.

Properties of the parameter channel

- One 16-bit address for each parameter number and subindex.
- Transfer of different parameters in one access (multiple request).
- Entire fields or parts of fields can be transferred.
- Only one parameter request is processed at a time (no pipelining).
- A parameter request/response must fit into a data set (on PROFIBUS: max. 240 bytes).
- The header of the task or the response are user data.
- Only 1 master or 1 supervisor on a frequency converter can be cyclically accessed at a time.

Structure of parameter request and parameter response

Each parameter request consists of three parts:

Request header:

ID for the request and number of parameters being accessed.

Parameter address:

Addressing a parameter. If multiple parameters are being accessed there will be a corresponding number of parameter addresses. The parameter address appears in the request and not in the response.

Parameter value:

For each parameter addressed there is a segment for the parameter values. Depending on the request ID, the parameter values appear either only in the request or in the response.

Table 7-10 Parameter request

	Word	
	Byte	**Byte**
Request header	Request reference	Request ID
	Drive object ID	Qty Parameters
1. Parameter address	Attribute	Qty of elements
	Parameter number (PNU)	
	Subindex	
…		
n. parameter address	Attribute	Qty of elements
	Parameter number (PNU)	
	Subindex	
1. parameter value(s) (only in the case of "change parameters" request)	Format	Qty Values
	Values	
	…	
…		
n. parameter value(s)	Format	Qty Values
	Values	
	…	

Table 7-11 Parameter response

	Word	
	Byte	**Byte**
Response header	Request reference mirrored	Request ID
	Drive object ID mirrored	Qty Parameters
1. parameter value(s) (only after a "request")	Format	Qty Values
	Values or error values	
	…	
…		
n. parameter value(s)	Format	Qty Values
	Values or error values	
	…	

Description of the fields for a parameter request and response

Table 7-12 Description of the fields for parameter requests

Field	Data type	Values	Remark
Request reference	Unsigned 8	0x01 … 0xFF	
	Unambiguous identification of the request/response pair for the master. The master changes the request reference with each new request. The slave mirrors the request reference in its response.		
Request ID	Unsigned 8	0x01 0x02	Read request, write request
	Specifies the request type. In the event of a write request the changes are saved to volatile memory (RAM). A save operation is required in order to transfer the data to non-volatile memory (P0971).		
Drive object ID	Unsigned 8	0x00 … 0xFF	Number
	Setting for the drive object number with a drive unit with more than one drive object. Different drive objects with separate parameter number ranges can be accessed at the same DPV1 connection.		
Qty Parameters	Unsigned 8	0x01 … 0x27	No. 1 ... 39 Limited by the length of the DPV1 telegram
	In the case of multiple requests, defines the number of adjacent areas for the parameter address and/or the parameter value for multiple parameter requests. The number of parameters = 1 for individual requests.		
Attribute	Unsigned 8	0x10 0x20 0x30	Value Description Text (not implemented)
	Type of parameter element being accessed.		
Qty of elements	Unsigned 8	0x00 0x01 … 0x75	Special function no. 1 ... 117 Limited by the length of the DPV1 telegram
	Number of field elements being accessed.		
Parameter number	Unsigned 16	0x0001 … 0xFFFF	No. 1 … 65535
	Number of parameter being accessed.		

Field	Data type	Values	Remark
Subindex	Unsigned 16	0x0001 … 0xFFFF	No. 0 … 65535
	Addresses the first field element of the parameter to be accessed.		
Format	Unsigned 8	0x02	Data type: integer 8
		0x03	Data type: integer 16
		0x04	Data type: integer 32
		0x05	Data type: unsigned 8
		0x06	Data type: unsigned 16
		0x07	Data type: unsigned 32
		0x08	Data type: floating point
		Other values	See PROFIdrive profile
		0x40	Zero (without values as positive sub-response to a write request)
			Byte
		0x41	Word
		0x42	Doubleword
		0x43	Faults
		0x44	
	Format and number specify the correlated areas in the telegram which contain values. Data types conforming to the PROFIdrive profile should be preferred for write access. Bytes, words and doublewords may also be used as alternatives		
Qty Values	Unsigned 8	0x00 … 0xEA	No. 0 ... 234 Limited by the length of the DPV1 telegram
	Specifies the number of successive values.		
Values	Unsigned 16	0x0000 … 0x00FF	
	The values of the parameters for read or write access. A zero byte is appended if the values result in an odd number of bytes. This ensures integrity of the word structure in the telegram.		

Table 7-13 Description of the fields for parameter requests

Field	Data type	Values	Remark	
Request ID	Unsigned 8	0x01 0x02 0x81 0x82	Read request (+) Write request (+) Read request (–) Write request (–)	Request positive, status ok Request negative, error state
	Mirrors the request ID and indicates whether the execution of the request has been positive or negative. Negative means: part of the - or the entire request cannot be executed. The error values are transferred in place of the values for every sub-response.			
Drive object ID	See the table above			
Qty Parameters	See the table above			
Format	See the table above			
Qty Values	See the table above			
Values	See the table above			
Error values	Unsigned 16	0x0000 … 0x00FF	Meaning of the error values: See the next table	
	The error values in the event of a negative response. A zero byte is appended if the values result in an odd number of bytes. This ensures integrity of the word structure in the telegram.			

Note

The DRIVE-ES SIMATIC block package provides function blocks within the standard block libraries for writing/reading parameters, including a few examples.

Error values in parameter responses

Table 7-14 Error values in parameter responses

Error value	Meaning	Remark	Additional inf.
0x00	Invalid parameter number	Access to a non-existent parameter.	–
0x01	Parameter value cannot be modified.	Attempt to modify a read-only parameter.	Subindex
0x02	Low or high limit exceeded	Attempted modification with value outside limits.	Subindex
0x03	Invalid subindex	Access to non-existing subindex.	Subindex
0x04	No field	Access with subindex to non-indexed parameter.	–
0x05	Incorrect data type	Attempt to modify with a value which is incompatible with the data type of the parameter.	–
0x06	Invalid "Set" action (only reset is allowed)	Attempt to modify with a value unequal 0 in a situation where this is not allowed.	Subindex
0x07	The descriptive element cannot be modified.	Attempt to modify a read-only descriptive element.	Subindex
0x09	No descriptive data	Access to a non-existent description (parameter value exists).	–
0x0B	No priority active	Attempted modification without active priority.	–
0x0F	No text field available	Attempt to access a non-existent text field (parameter value exists).	–
0x11	Request cannot be executed on account of the operating state	Access is temporarily disabled for unspecified reasons.	–
0x14	Invalid value	Attempt to modify with a value which lies within the limits, however, is invalid for other permanently valid reasons (parameters with permanently defined values).	Subindex
0x15	Response too long	The length of the present response exceeds the maximum transfer length.	–
0x16	Invalid parameter address	Invalid or unsupported value for attribute, number of elements, parameter number, subindex, or a combination of these.	–
0x17	Invalid format	Write request for an invalid or unsupported parameter data format.	–
0x18	Inconsistent qty. of values	Write request - The number of values in parameter data and the number of elements in the parameter address do not match.	–
0x19	Drive object is not present	Access to a drive object which is not present.	–
0x20	The parameter text element cannot be modified.	Attempt to modify a read only parameter text element.	Subindex

7.4.3.2 Examples

Writing PROFIdrive parameters

In order to make use of DS47, a data block first needs to be created in Simatic Manager. This implements the data set structure using the parameter request table as a template. In this example, a data set is stored in DB47 for the purpose of changing P1082 (maximum frequency).

P1082 is to be changed to 100 Hz.

Adresse	Name	Typ	Anfangswer	Kommentar
0.0		STRUCT		
+0.0	Request_Reference	BYTE	B#16#1	
+1.0	Request_ID	BYTE	B#16#2	writing Request
+2.0	AxisNo	BYTE	B#16#1	
+3.0	Number_of_Parameterss	BYTE	B#16#1	1 Parameter
+4.0	Attribute	BYTE	B#16#10	Value of Parameter
+5.0	Number_of_Elements	BYTE	B#16#1	1 Element
+6.0	Parameter_Number	WORD	W#16#43A	P1082
+8.0	Subindex	WORD	W#16#0	Index 0
+10.0	Format	BYTE	B#16#8	Format = Float
+11.0	Number_of_Values	BYTE	B#16#1	1 Value
+12.0	Valuee	REAL	1.000000e+	Value=1.0
=16.0		END_STRUCT		

Figure 7-5 DB47 (DS47 write job)

This data set is then sent to the FC in the context of cyclic program execution (e.g., OB1) using SFC58.

In order to be able to read the reply data set from the FC, an additional data block again needs to be created. For this purpose, DB1 is added to the project. To ensure as flexible a response as possible, DB1 is created as a data field with a length of 240 bytes and no defined structure. The response must then be evaluated on a request-specific basis.

Adresse	Name	Typ	Anfangswer	Kommentar
0.0		STRUCT		
+0.0	Request_Reference	BYTE	B#16#0	
+1.0	Request_ID	BYTE	B#16#0	
+2.0	AxisNo	BYTE	B#16#0	
+3.0	Number_of_Parameterss	BYTE	B#16#0	
+4.0	buffer	ARRAY[0..234]		
*1.0		BYTE		
=240.0		END_STRUCT		

Figure 7-6 DB1 (DS47 response)

Once the data blocks have been created, a parameter request is written via data set DS47 using S7 function SFC58. Then, a reply data set is read with SFC59 and stored in DB1. In this example, the start of this process is triggered by a positive edge at input In0.0.

Network 1 : Title:

on positive edge of In0.0 M8.0 is set

```
U     E      0.0
FP    M      1.0
S     M      8.0
```

Network 2 : Title:

On positive edge of M8.0 the first 16 Byte portion of DB47 is being transfered as dataset 47 to logical address 256.
On negative edge of „busy“ M8.2 is set.

```
CALL  "WR_REC"
 REQ     :=M8.0
 IOID    :=B#16#54
 LADDR   :=W#16#100
 RECNUM  :=B#16#2F
 RECORD  :=P#DB47.DBX0.0 BYTE 16
 RET_VAL:=MW10
 BUSY    :=M8.1

U     M      8.1
R     M      8.0

U     M      8.1
FN    M      1.1
S     M      8.2
```

Network 3 : Title:

With M8.2=1 the reply data set is read from the logical address 256.

```
CALL  "RD_REC"
 REQ     :=M8.2
 IOID    :=B#16#54
 LADDR   :=W#16#100
 RECNUM  :=B#16#2F
 RET_VAL:=MW12
 BUSY    :=M8.3
 RECORD  :=P#DB1.DBX0.0 BYTE 240

U     M      8.3
R     M      8.2
```

Figure 7-7 Request processing in OB1

Once the parameter request has been executed successfully, the request header (defined in DB47) must be mirrored in DB1 (requestID does not indicate any errors).

To view the data currently stored in DB1, open DB1 in Simatic Manager and click the glasses icon.

The parameter response table provides information about the structure of the reply data set.

Reading PROFIdrive parameters (example)

In order to make use of DS47, a data block first needs to be created in SIMATIC Manager. The structure of the data set will then be implemented in it. In this example, a data set is stored in DB48 for the purpose of reading P0947 (error buffer).

Adresse	Name	Typ	Anfangswer	Kommentar
0.0		STRUCT		
+0.0	Request_Reference	BYTE	B#16#1	
+1.0	Request_ID	BYTE	B#16#1	reading Request
+2.0	AxisNo	BYTE	B#16#1	
+3.0	Number_of_Parameterss	BYTE	B#16#1	1 Parameter
+4.0	Attribute	BYTE	B#16#10	Value of Parameter
+5.0	Number_of_Elements	BYTE	B#16#8	8 Elements
+6.0	Parameter_Number	WORD	W#16#3B3	P947
+8.0	Subindex	WORD	W#16#0	Index 0
=10.0		END_STRUCT		

Figure 7-8 DB48 (DS47 read job)

This data set is then sent to the FC in the context of cyclic program execution (e.g., OB1) using SFC58.

In order to be able to read the reply data set from the FC, an additional data block needs to be created. For this purpose, DB1 is added to the project. To ensure as flexible a response as possible, DB1 is created as a data field with a length of 240 bytes and no defined structure. The response must then be evaluated on a request-specific basis.

Adresse	Name	Typ	Anfangswer	Kommentar
0.0		STRUCT		
+0.0	Request_Reference	BYTE	B#16#0	
+1.0	Request_ID	BYTE	B#16#0	
+2.0	AxisNo	BYTE	B#16#0	
+3.0	Number_of_Parameterss	BYTE	B#16#0	
+4.0	buffer	ARRAY[0..234]		
*1.0		BYTE		
=240.0		END_STRUCT		

Figure 7-9 DB1 (DS47 response)

Once the data blocks have been created, a parameter request is written via data set DS47 using S7 function SFC58. Then, a reply data set is read with SFC59 and stored in DB1. In this example, the start of this process is triggered by a positive edge at input In0.0.

on positive edge of In0.0 M8.0 is set

```
U     E      0.0
FP    M      1.0
S     M      8.0
```

Network 2 : Title:

On positive edge of M8.0 the first 16 Byte portion of DB47 is being transfered as dataset 47 to logical address 256.
On negative edge of „busy“ M8.2 is set.

```
CALL  "WR_REC"
 REQ     :=M8.0
 IOID    :=B#16#54
 LADDR   :=W#16#100
 RECNUM  :=B#16#2F
 RECORD  :=P#DB48.DBX0.0 BYTE 10
 RET_VAL:=MW10
 BUSY    :=M8.1

U     M      8.1
R     M      8.0

U     M      8.1
FN    M      1.1
S     M      8.2
```

Network 3 : Title:

With M8 The reply data set will be read from the logical address 256.

```
CALL  "RD_REC"
 REQ     :=M8.2
 IOID    :=B#16#54
 LADDR   :=W#16#100
 RECNUM  :=B#16#2F
 RET_VAL:=MW12
 BUSY    :=M8.3
 RECORD  :=P#DB1.DBX0.0 BYTE 240

U     M      8.3
R     M      8.2
```

Adress	Name	Typ	Anfangswert	Aktualwert
0.0	Request_Refer	BYTE	B#16#0	B#16#01
1.0	Request_ID	BYTE	B#16#0	B#16#01
2.0	AxisNo	BYTE	B#16#0	B#16#01
3.0	Number_of_Par	BYTE	B#16#0	B#16#01
4.0	buffer[0]	BYTE	B#16#0	B#16#42
5.0	buffer[1]	BYTE	B#16#0	B#16#08
6.0	buffer[2]	BYTE	B#16#0	B#16#00
7.0	buffer[3]	BYTE	B#16#0	B#16#46
8.0	buffer[4]	BYTE	B#16#0	B#16#00
9.0	buffer[5]	BYTE	B#16#0	B#16#00
10.0	buffer[6]	BYTE	B#16#0	B#16#00
11.0	buffer[7]	BYTE	B#16#0	B#16#00
12.0	buffer[8]	BYTE	B#16#0	B#16#00
13.0	buffer[9]	BYTE	B#16#0	B#16#00
14.0	buffer[10]	BYTE	B#16#0	B#16#00
15.0	buffer[11]	BYTE	B#16#0	B#16#00
16.0	buffer[12]	BYTE	B#16#0	B#16#00
17.0	buffer[13]	BYTE	B#16#0	B#16#00
18.0	buffer[14]	BYTE	B#16#0	B#16#00
19.0	buffer[15]	BYTE	B#16#0	B#16#00
20.0	buffer[16]	BYTE	B#16#0	B#16#00
21.0	buffer[17]	BYTE	B#16#0	B#16#00
22.0	buffer[18]	BYTE	B#16#0	B#16#00
23.0	buffer[19]	BYTE	B#16#0	B#16#00
24.0	buffer[20]	BYTE	B#16#0	B#16#00
25.0	buffer[21]	BYTE	B#16#0	B#16#00

Figure 7-10 Example DB1 after P947 has been read out successfully with F70 pending (P947.0=70)

7.5 Commissioning of the fail-safe functions

General steps

Those parameters that are marked with an asterisk ("*") offer a wider variety of setting options than the ones listed here. For information on additional setting options, please refer to the List Manual.

When making changes to fail-safe functions, the following steps are mandatory:

Parameter	Description	Unit	Standard value	Min.	Max.
P0010 = 95	**Commissioning parameter*** 95: Commissioning of fail-safe functions		0	0	95
P9761	**SI password input** These parameters are used to enter the security password necessary for accessing and changing fail-safe function parameters.	-	0	1000	99999
Change the required fail-safe parameters and then follow the steps below to exit parameterization:					
P9799	**Checksum for SI parameters** Checksum of fail-safe function parameters. Enter the value from r9798.	-	0000h	0000h	FFFFh
P9899	**Checksum for SI parameters** Checksum of fail-safe function parameters. Enter the value from r9898.	-	0000h	0000h	FFFFh
P3900 = 10	**End of safety commissioning*** 10: Accept changes to fail-safe function parameters. 11: Reject changes to fail-safe function parameters.		0	0	11

Parameters for fail-safe functions

The table below provides an overview of all the fail-safe function parameters. Access level 3 applies in respect of the fail-safe parameters (P0003 = 3). The values of fail-safe parameters can only be changed with a password (P9761). For a more detailed description, please refer to the List Manual.

CUs with integrated fail-safe functions are equipped with two processors. To distinguish between them, they shall be referred to as follows:

- P1 denotes processor 1.
- P2 denotes processor 2.

Table 7-15 Parameters for fail-safe functions

Parameter	Description	Unit	Standard value	Min.	Max.
Processor 1 (drive processor)					
P9601	SI enable parameter	-	2	0	2
P9603	SI selection of safety source	-	0	0	48
P9659	SI maximum time until test stop	h	8.0	0.1	8760.0
r9660	SI time remaining until test stop	h	-	-	-
P9680	SI braking ramp deceleration	ms	250	10	99000
P9681	SI braking ramp coasting down time	ms	10000	100	99000
P9682	SI minimum speed for detecting standstill	Hz	5.0	2.0	20.0
P9690	SI setpoint for SLS	Hz	10.0	1.0	300.0
P9691	SI tolerance for SLS	Hz	13.0	5.0	302.0
P9692	SI response to SLS selection	-	1	0	2
r9760	SI internal password	-	12345	1000	99999
P9761	SI password input	-	0	1000	99999
P9762	SI password change	-	0	1000	99999
P9763	SI confirmation of password change	-	0	1000	99999
r9770	SI FW version	-	-	-	-
r9771	SI hardware functions	-	-	-	-
r9772	SI status word	-	-	-	-
r9798	SI display checksum	-	0000h	0000h	FFFFh
P9799	SI parameter checksum	-	0000h	0000h	FFFFh
Processor 2 (communications processor)					
P9801	SI enable parameter	-	2	0	2
P9803	SI selection of safety source	-	0	0	48
P9880	SI braking ramp deceleration	s	0.250	0.010	99.000
P9881	SI braking ramp coasting down time	s	10.000	0.100	99.000
P9882	SI minimum speed for detecting standstill	kHz	0.005	0.002	0.020
P9890	SI setpoint for SLS	kHz	0.010	0.001	0.300
P9891	SI tolerance for SLS	kHz	0.013	0.005	0.302
P9892	SI response to SLS selection	-	1	0	2
r9898	SI display checksum	-	0000h	0000h	FFFFh
P9899	SI parameter checksum	-	0000h	0000h	FFFFh

Password for fail-safe functions

Four parameters are assigned to the password protection system:

- r9760 - Shows the currently valid password for fail-safe function parameters.
- P9761 - Used to enter the password.
- P9762 - Used to enter a new password (5 digits without leading zeros (0)).
- P9763 - Used to confirm a new password.

When a password is entered (5 digits without leading zeros), it is compared to the password stored in r9760.

If it is correct, i.e., if the two passwords match, access is granted.

If the password is incorrect, the parameters for fail-safe functions are disabled and the user has to exit the commissioning mode for fail-safe functions manually using parameter P3900 = 11. Parameter P3900 = 11 clears all previous changes that have been made to the parameters for fail-safe functions.

Checksums

All parameters for fail-safe functions are verified with the aid of checksums, which guarantee the integrity of the data stored in the drive processor's memory.

There are four checksums, two for each processor:

- r9798 - Current checksum for P1
- P9799 - Reference checksum for P1
- r9898 - Current checksum for P2
- P9899 - Reference checksum for P2

7.5.1 General information on acceptance tests

Description

In order to check the safety function parameters, an acceptance test must be carried out after commissioning, after a reset and also whenever changes are made to a fail-safe parameter data set associated with safety functions (e.g., via MMC). The acceptance test must be logged and documented using appropriate means. This section contains an example of a duly completed acceptance report. Acceptance reports must be archived using appropriate means.

Acceptance test

An acceptance test must be carried out by the machine manufacturer in respect of any safety functions that are enabled on the system.

Authorized person, acceptance certificate

Each of the safety functions must be checked by the relevant authorized personnel. Each check must be documented/logged in an acceptance report and then signed off. The acceptance report must be enclosed with or attached to the system's log book.

In this context, the term "authorized personnel" refers to any member of the machine manufacturer's personnel with the requisite training and knowledge to carry out a safety function acceptance test correctly.

Note

It is essential for personnel to adhere precisely to the information/instructions and descriptive information regarding commissioning provided in the section of this manual entitled "Commissioning fail-safe functions".

Whenever changes are made to safety function parameters, a new acceptance test must be carried out and the results included in the form of an acceptance report.

The official acceptance report form can be found in the Appendix to these Operating Instructions.

What the results of a completed acceptance test must include

System documentation including details of fail-safe functions

- Description of the system and synopsis/block diagram
- Safety functions for each drive
- Description of fail-safe devices/equipment

Functional test

Used to check the individual safety functions that are implemented.

- "Safe Torque Off" (STO)
- "Safe Stop 1" (SS1)
- "Safely Limited Speed" (SLS)

Completing the report

Document/log the commissioning time and then sign.

- Check the safety function parameters.
- Document/log the checksums.
- Provide evidence to show that the data have been saved/archived.
- Sign.

Appendix

Records/printouts of measurements associated with the functional test.

- Alarm logs
- Printouts of curve characteristics

Note

The official acceptance report form can be found in the Appendix to these Operating Instructions.

7.6 Performing a reset to factory settings

Overview

All converter parameters can be restored to a defined original state by performing a reset to factory settings.

The original state can be restored by resetting the parameters to factory default by means of P0970. These factory-set values are indicated in the parameter list by means of the abbreviation "Def".

After a reset to factory settings, the following default settings will apply to the converter:

- Command and setpoint sources reset to fieldbus communication
- Control mode: basic V/f characteristic (P1300 = 0)
- Induction motor (P0300 = 1)

To facilitate the process of performing a reset to factory settings, the STARTER software offers self-explanatory buttons and operator dialogs for both the standard and fail-safe parameters.

Note

When the parameters are reset to the factory settings, the data transfer memory is reinitialized. As a result, data transfer will be suspended while the reset process is being performed.

⚠WARNING

Fail-safe parameters

If standard frequency converters are used only the reset to factory defaults by means of P0970 = 1 is of relevance.

If using frequency converters with fail-safe functions you have two reset options:

- P0970 = 1 only resets parameters which are irrelevant to fail-safe functions (application parameters).
  If P0970 = 1 is used to reset factory defaults on a frequency converter with fail-safe functions all application parameters will be reset, however, any parameter settings relating to fail-safe functions will be retained. That is, it is not necessary to carry out an acceptance test.
- P0970 = 10 (password protected) only resets parameters which relate to fail-safe functions.
  An acceptance test must be carried out if parameters relating to fail-safe functions have to be changed.

7.6.1 Factory settings

Factory default settings

After the frequency converter is reset to the factory settings, it can be operated without any additional parameterization provided the default settings of the frequency converter match the following data of a 4-pole motor:

Default line frequency	50 Hz
Rated motor voltage	P0304
Rated motor current	P0305
Rated motor output	P0307
Rated motor frequency	P0310
Rated speed	P0311
(We recommend a Siemens standard motor.)	
The following conditions must also be fulfilled:	
Control (ON/OFF command) through fieldbus	P0700=6
Asynchronous motor	P0300=1
Self-cooled motor	P0335=0
Motor overload factor	P0640=150 %
Setpoint input through fieldbus	P1000=6
Minimum frequency	P1080=0 Hz
Maximum frequency	P1082=50 Hz
Ramp-up time	P1120=10 s
Ramp-down time	P1121=10 s
Linear V/f characteristic	P1300=0

NOTICE

If the settings made go beyond the factory settings, then careful attention must be paid - depending on the complexity of the application - to the description of special functions and to the parameter list plus function diagrams when commissioning the frequency converter.

7.6.2 Resetting fail-safe parameters to default values

Description

Safe resetting to factory settings causes all fail-safe parameters to revert to their default values. Exceptions:

- r9760 SI internal password
- P9761 SI password input
- P9762 SI password change
- P9763 SI confirmation of password change

Required parameter settings

Parameter	**Description** (parameter name and factory setting (if this does not vary) in bold)
P0003 = 3	User access level* 1: Standard: Facilitates access to the most frequently used parameters. 2: Extended: Facilitates extended access, e.g., to converter I/O functions. 3: Expert level: Only to be used by experts.
P0004 = 0	Parameter filter* 0: All parameters
P0010 = 30	Commissioning parameter* 0: Ready 30: Factory setting, parameter transfer
P9761	SI password input Enter security password
P0970 = 10	Reset to factory settings* 0: Disabled 1: Reset application parameters 10: Reset parameters for fail-safe functions
BUSY	Once the reset to factory settings has been completed, P0970 and P0010 are set to 0.

Series commissioning and operation

8

Overview

The operating and startup characteristics depend on the settings of the converter during commissioning.

The following special operating characteristics are covered in this section:

- Transfer of frequency converter parameters to external storage media
- Simple standard commissioning of several frequency converters and the response when a frequency converter is replaced
- the normal operating behavior of the frequency converter.

Note

The power supply cable must be fused in accordance with its cable cross-section. All 400 V components in the ET 200pro station, i.e. motor starters and converters, which are supplied from a shared power bus, are protected by means of device-internal measures.

DANGER

During operation and a short time after switch-off, the enclosure can reach temperatures which can cause burns or trigger a fire.

Requirements

The software user functions require functional hardware and software which have been put into operation.

8.1 Transfer of the frequency converter parameter assignment

The mechanisms by means of which parameters are transferred to external storage media play an important role both under normal frequency converter operating conditions and during standard commissioning and device replacement. For this reason, the different media and their associated transfer methods are explained below.

8.1.1 Storage media for frequency converter parameters

Internal memory

All frequency converter parameter values are stored in a ROM block and are transferred to the RAM once the device has powered up. Changes to factory settings can be saved in an EEPROM so that they are powerfail-proof.

External memory

The frequency converter parameter values can be transferred to external storage media and saved there. Options are:

- PC hard disk
- PLC memory
- MMC

Note

The file format for the MMC is FAT. Other file formats, such as FAT32 or NTFS, are not compatible with uploading or downloading parameter sets from/to the converter.

Formatting is performed via the following DOS command line:

C:\>format volume /FS:FAT, where "volume" must be replaced by the drive name of the MMC (e.g., A).

Please note that formatting causes all data to be deleted from the MMC.

8.1.2 Parameter transfer - Terms

Upload

"Upload" refers to the transfer of parameters from the internal memory to an external storage medium (e.g., MMC).

Download

"Download" refers to the transfer of parameters from an external storage medium to the frequency converter's internal memory.

Supplementary conditions

The following supplementary conditions must be observed in respect of uploads/downloads:

- Once the upload/download procedure is under way, there is no way of stopping it again.
- If the data being downloaded are incompatible with the frequency converter, the relevant parameters in the converter will revert to their default values.
- All the LEDs will flash during the upload/download process. On successful completion of the process, the "RY/RDY" LED will light up.

⚠CAUTION

Downloading parameters between different frequency converters or firmware versions is not recommended.

It is possible to download parameter sets between different frequency converters, but the user bears full responsibility for the consistency of the downloaded parameter set, as the sets may differ from one another.

8.1.3 Parameter transfer with MMC

Upload from frequency converter to an MMC

The frequency converter features an MMC slot, into which a memory card can be inserted. An upload of parameters from EEPROM to the MMC can only be triggered manually.

Prerequisites:

- The upload frequency converter's power supply must be connected.
- The upload frequency converter must be in the "Ready" state.
- You must have an MMC, type 6SL3254-0AM00-0AA0, at your disposal.

Procedure

Parameters	**Description** (Parameter name and default setting (if this does not vary) in bold)	**Setting**
	Disassemble frequency converter, insert MMC into rear of frequency converter and re-assemble frequency converter - Carry out the following steps in respect of the parameter set that is to be uploaded:	
P0010 = 30	**Commissioning parameter*** **0: Ready** 1: Quick comm. 2: Frequency converter 30: Factory setting, parameter transfer 95: Commissioning of fail-safe functions	
P0804 = …	**Select clone file** **0: clone00.bin** … 99: clone99.bin **Remark**: You can use P0804 to select the name of the clone file. In theory, up to a maximum of 100 (0 ... 99) parameter sets can be stored on one MMC.	
P0802 = 2	**Transfer data from EEPROM** **0: Disabled** 2: Start MMC transfer	
	If the upload was successfully completed, P0010 and P0802 are set to 0 and the "RY/RDY" LED is lit.	

An unsuccessful upload is signaled by an error message.

Download from an MMC to the frequency converter

The transfer of parameters from the MMC to the frequency converter's EEPROM can be triggered manually or performed automatically.

Note

When making use of this download procedure, you must bear in mind the following important constraints:

- During the download procedure, the frequency converter will not be able to respond to any commands.
- Once the download procedure is under way, there is no way of stopping it again.
- If the data being downloaded are incompatible with the frequency converter, the relevant parameters in the frequency converter's memory will revert to their default values.
- In the event of an unsuccessful download, the frequency converter will not function as it should.

The LEDs should flash when parameters are downloaded from an MMC to the frequency converter's EEPROM. However, if the frequency converter is in fault status, this will be afforded higher signaling priority by the LEDs than the download process. In such an event, there is no way of knowing whether or not the parameter set has been downloaded correctly.

Manual download

In the case of a manual download, all the necessary parameters (with the exception of fail-safe parameters) will be downloaded to the frequency converter.

Prerequisites

- The download frequency converter's power supply must be connected.
- The download frequency converter must be in the "Ready" state.
- You must have an MMC, type 6SL3254-0AM00-0AA0, at your disposal.

Procedure

Parameters	**Description** (Parameter name and default setting (if this does not vary) in bold)	**Setting**
	Disassemble frequency converter, insert MMC into rear of frequency converter and re-assemble frequency converter; then perform a manual download.	
P0010 = 30	**Commissioning parameter*** **0: Ready** 1: Quick comm. 2: Frequency converter 30: Factory setting, parameter transfer 95: Commissioning of fail-safe functions	
P0804 = …	**Select clone file (for download)** **0: clone00.bin** … 99: clone99.bin	
P0803 = 2	Transfer data to EEPROM 0: Disabled 2: Start MMC transfer	
	If the download was successfully completed, P0010 and P0803 are set to 0 and the "RY/RDY" LED is lit.	

Remark: It is possible to transfer data from one MMC to another using a commercially available card reader.

An unsuccessful download is signaled by an error message.

Automatic download

In the case of an automatic download, all parameters are transferred to the frequency converter, including the fail-safe parameters.

P8458 is the parameter responsible for controlling automatic downloads on power-up.

Note

MMC for "automatic download"

The file clone00.bin is always used for an automatic download.

The user must ensure that clone00.bin (saved as "clone00.bin" on the PC with the STARTER software) is available upon power-up on the MMC that is being used for the automatic parameter download. Otherwise, the automatic download will not be performed.

Possible settings for P8458 and its functions are specified below.

P8458 = 0	Automatic parameter download from the MMC is disabled.
P8458 = 1	Automatic parameter download from the MMC once only (when the frequency converter next powers up (default setting)). After the download, P8458 will be set to 0.
P8458 = 2	Automatic parameter loading from the MMC each time the frequency converter powers up.

The converter is ready after a successful automatic download. A successful automatic download means:

- All parameters on the MMC were written into the converter EEPROM.
- The application ID on the MMC is the same as the configured application ID for this slot.

An unsuccessful download is signaled by an error message.

P8458 after an automatic download

The table below shows how the parameter P8458 is affected by the value which might be saved on the MMC.

Table 8-1 Settings of P8458 after an automatic parameter download from the MMC

Setting of P8458 in the frequency converter EEPROM	Setting of P8458 in the MMC	Setting of P8458 after startup	Remark
0	0	0	Possible only in case of a replacement
0	1	0	
0	2	2	
1	0	0	---
1	1	0	---
1	2	2	---
2	0	0	---
2	1	0	---
2	2	2	---

8.1.4 Parameter transfer with PC (STARTER)

Upload from frequency converter to the PC

Parameters are uploaded from the frequency converter's RAM to a project file on a PC's hard disk using STARTER. STARTER can be connected via a fieldbus or directly to the frequency converter's RS232 interface.

Prerequisites

- You must have a converter with a suitable parameter set at your disposal (upload converter).
- STARTER must be installed on the PC used for standard commissioning.
- The upload converter's power supply must be connected.
- The upload converter is in the "Ready to run" state.

Connect the STARTER PC to the upload frequency converter via RS232 (point-to-point connection, appropriate connecting cable required) or via fieldbus, press the online button ("Connect to target system") and perform the upload using the button.

Remark

An online connection can only be established between the PC and frequency converter via fieldbus if the following conditions are met:

- The interface module of the ET 200 station is running in DPV1 mode.
- There is no CPU between the PC and the frequency converter (also applies to the

Download from PC to the frequency converter

In the case of a manual download, all parameters (with the exception of fail-safe parameters) will be transferred to the frequency converter.

The parameter download is triggered via STARTER, from the project file in the frequency converter's RAM.

Note

When making use of this download procedure, you must bear in mind the following important constraints:

- During the download process, the frequency converter will not be able to respond to any commands.
- Once the download procedure is under way, there is no way of stopping it again.
- If the data being downloaded are incompatible with the frequency converter, the relevant parameters in the frequency converter's memory will revert to their default values.
- In the event of an unsuccessful download, the frequency converter will not function as it should.

When parameters are being downloaded from the PC to the frequency converter's EEPROM, the LEDs will flash. If the frequency converter experiences a fault condition, the fault is indicated by the LEDs (SF on, RY/RDY off). The download will be carried out regardless.

Prerequisites

- The download converter's power supply must be connected.
- The download converter is in the "Ready to run" state.

Connect the STARTER PC to the download frequency converter via RS232 (point-to-point connection, appropriate connecting cable required) or via fieldbus, press the online button and perform the download using the ("Download project to target system") button.

The transferred parameters must then be saved in the frequency converter so that they are powerfail-proof by pressing the ("RAM to ROM") button.

Remark

An online connection can only be established between the PC and frequency converter via fieldbus if the following conditions are met:

- The interface module of the ET 200 station is running in DPV1 mode.
- The PC must be connected to the fieldbus directly.

See also

Series commissioning (Page 134)

8.1.5 Parameter transfer with PLC

Parameters can be uploaded and downloaded via fieldbus using the transfer mechanisms of data set 47. For detailed information, refer to "Commissioning and Optimization".

8.1.6 Fault codes during upload and download

Fault codes

If a fault occurs during an automatic download procedure, the frequency converter returns to the parameter set that was previously stored in the EEPROM and the following fault codes are generated:

Error	Cause	Remedy/Test
F00061	No MMC inserted	• MMC faulty? • Insert an MMC and attempt the upload/download again.
F00062	MMC contents invalid	• MMC faulty? • Parameter valid for this frequency converter?
F00063	MMC contents incompatible	• MMC faulty? • Parameter set clone00.bin available on the MMC • Parameter valid for this frequency converter?
F00395	Different application ID after download	See below

NOTICE

Once parameters have been uploaded from and downloaded to different frequency converters, the parameter settings must be checked.

Downloading parameters from another frequency converter may cause a fault to occur with F00063 output, if there are parameters that cannot be downloaded (check P0949 regarding the (first) parameter number that cannot be downloaded).

If fault code F00061 or F00063 occurs during startup, it can only be cleared by shutting down and restarting.

Remedy for F00395

If fault F00395 occurs, the loaded parameter set must be checked and confirmed by clearing code F00395. The procedures are different for standard and fail-safe frequency converters.

F00395 for standard frequency converter

For a frequency converter without fail-safe functions, code F00395 can be cleared by means of:

- Setting P7844 = 0 (confirmation of parameter download) or
- Setting P7844 = 2 (rejection of parameter download)
  → The frequency converter must be commissioned.
- Fault F00395 is acknowledged automatically by both P7844 settings.

⚠WARNING

In acknowledging fault F00395, the user assumes full responsibility for the parameters saved in the frequency converter. In the "Ready to run" state, the frequency converter can be started after acknowledgement by means of an OFF1/ON command.

F00395 for fail-safe frequency converter

In the case of frequency converters with integrated fail-safe functions, it is necessary to perform an acceptance test. To clear F00395 on a frequency converter with integrated fail-safe functions, proceed as follows:

- P0010 = 30
- P9761 = Fail-safe password
- Setting P7844 = 0 (confirmation of parameter download) or
- Setting P7844 = 2 (rejection of parameter download)
  → The frequency converter must be commissioned.
- Fault F00395 is acknowledged automatically by both P7844 settings.
- Perform an acceptance test.

⚠WARNING

In acknowledging fault F00395, the user assumes full responsibility for performing the acceptance test. The frequency converter must not be switched on before an acceptance test is properly completed. In the "Ready to run" state, the frequency converter can be started by means of an OFF1/ON command.

8.2 Series commissioning and replacement of the frequency converter

8.2.1 Application ID

The application ID is an important parameter for frequency converter standard commissioning and replacement. It is specified in HW Config when the frequency converter is configured (see Planning/Configuring) and saved in the PLC.

The application ID is designed to uniquely identify the frequency converter's parameter assignment and to prevent frequency converters being swapped incorrectly.

Saving the application ID in the frequency converter

The very first time a connection is established between the PLC and frequency converter, the application ID is accepted into the frequency converter and saved so that it is powerfail-proof.

The frequency converter's application ID is also transferred and saved when the frequency converter parameters are uploaded to an MMC or in STARTER.

Application ID during standard commissioning or replacement

When the frequency converter is replaced or after it has been parameterized by means of a parameter download, the frequency converter receives the application ID from the PLC and compares this value with the one saved in the frequency converter. If both values are identical, the frequency converter is ready to run. If the values differ, the frequency converter outputs fault F00395. In this case, you must check why the application IDs do not match.

Options for changing the application ID

There are two options for changing the application ID in the frequency converter:

- Rejection of the parameter download
- Acceptance of the parameter download

See "Fault codes during upload and download".

The application ID can, of course, be changed in the PLC too. Once the PLC has been restarted, the modified application ID is transferred to the frequency converter.

8.2.2 Series commissioning

Overview

The term series commissioning refers to the process of transferring the parameter set from one frequency converter to a number of other frequency converters in order to carry out quick commissioning of identical applications (e.g. series machines or groups of converters).

Series commissioning is divided into the following steps:

- Creating a valid parameter set
- Uploading this parameter set
- Downloading the uploaded parameter set to the new frequency converter

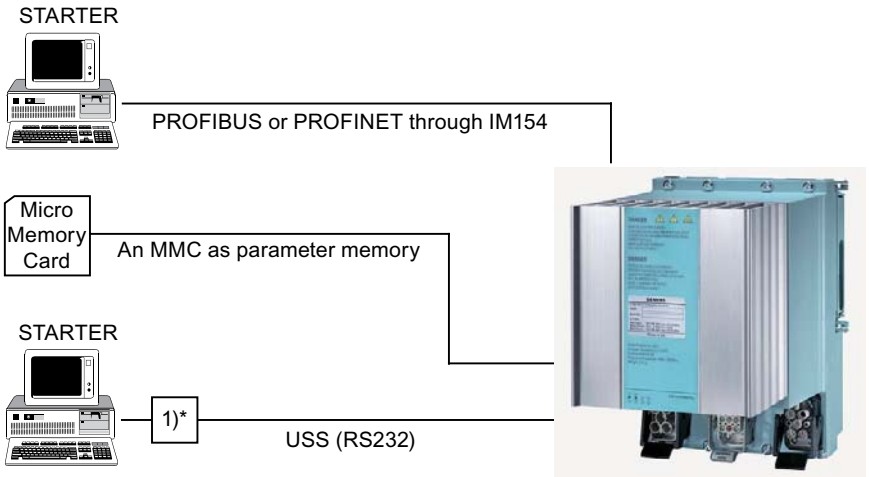
The precondition for carrying out series commissioning is that there must be a suitable parameter set available. This parameter set can be created by using the STARTER software for frequency converter parameterization.

⚠ CAUTION

Downloading parameters between different firmware versions can lead to incorrect parameter settings.

The LEDs should flash when parameters are downloaded from an MMC to the frequency converter's EEPROM (e.g. during series commissioning). The parameters must be checked after a download.

As soon as you have a frequency converter with a suitable parameter, you can upload the parameter set. The next step is then to download it to the new frequency converter using the STARTER software or MMC.



* is essential for the connection

1) RS232 interface cable (optical)

Figure 8-1 Series commissioning interfaces

⚠WARNING

All the data interfaces, including the digital and analog interfaces, are reinitialized for the series commissioning. This will interfere temporarily with data transfer or will cause the digital outputs to switch over.

Before embarking on series commissioning, you must secure any dangerous loads.

To do this, proceed as follows:

- Lower the load to the ground or
- Secure the load using the motor holding brake.

Standard commissioning sequence with STARTER

1. Configure all frequency converters to be involved in standard commissioning with the same application ID.
2. Commission the first frequency converter.
3. Upload from frequency converter to the PC: Frequency converter parameters are saved on the PC.
4. Download from PC to the frequency converter: The saved parameters are transferred to other frequency converters.

Note

In the case of a download with STARTER, all the necessary parameters (with the exception of fail-safe parameters) will be downloaded to the frequency converter.

See also

Parameter transfer with PC (STARTER) (Page 129)

Standard commissioning sequence with MMC

1. Configure all frequency converters to be involved in standard commissioning with the same application ID.
2. Commission the first frequency converter.
3. Upload from frequency converter to an MMC: Frequency converter parameters are saved on an MMC.
4. Download from an MMC to the frequency converter: The saved parameters are transferred to other frequency converters. The download can be performed manually or automatically.

Note

In the case of a manual download, all the necessary parameters (with the exception of fail-safe parameters) will be downloaded to the frequency converter.

See also

Parameter transfer with MMC (Page 126)

8.2.3 Replacing a frequency converter

With regard to the response of the frequency converter after a replacement it is necessary to distinguish whether an MMC is plugged in the frequency converter or not.

Frequency converter without MMC

After replacement, the frequency converter signals the error F00395 – unless the application ID for this slot is the same as the application ID of the slot from which the frequency converter originates.

Frequency converter with MMC

After plugging in, the frequency converter will carry out an automatic download from the MMC only if P8458 > 0 (see "Transfer of parameters").

After replacement, the frequency converter signals the error F00395 – unless the application ID for this slot is the same as the application ID of the slot from which the frequency converter originates.

⚠WARNING

Replacement constraints

The following must be taken into account prior to replacement:

- The user is responsible for ensuring that the MMC contains the correct parameter set.
- The user is responsible for ensuring that the application is in a safe state before performing a replacement during operation.

Instructions on how to replace a frequency converter correctly

⚠CAUTION

Parameter compatibility

In order to ensure full parameter compatibility, we recommend uploading the parameters to a new MMC prior to replacing the frequency converter.

1. Unplug the frequency converter
2. Remove the MMC

The following must be taken into account when inserting the frequency converter:

1. Push the MMC into the MMC slot before you insert the frequency converter
2. Plug in the new frequency converter

8.3 Operational performance of the converter

Description

A normal power-up procedure refers to the converter starting up after it has been switched off and on again, or after a power failure. It can be performed with or without an MMC.

Normal startup without MMC

Following a load cycle or a power failure, the frequency converter reads the parameters from the EEPROM into the RAM.

Normal startup with MMC

The frequency converters have been designed so that they can automatically detect whether an MMC is available. The level of interaction between the frequency converter and the MMC is controlled by parameter P8458.

Possible settings for P8458 and its functions are specified below.

P8458 = 0:	Parameters not automatically downloaded from the MMC.
P8458 = 1:	Parameters automatically downloaded from the MMC once (when frequency converter next powers up (factory setting)). After the download, P8458 will be set to 0.
P8458 = 2:	Parameters automatically downloaded from the MMC (if available) each time the frequency converter powers up.

Once the automatic download is complete, parameter P8458 will be set to 0 (provided that it had the value 1 before the download), thereby disabling any other automatic parameter downloads.

If parameter P8458 is set to 1 or 2 and no MMC is available, the converter begins with the EEPROM parameters without messages or fault codes.

Cyclic data exchange during operation

The frequency converter is controlled via the fieldbus by means of cyclic data traffic. The frequency converter receives control commands and the frequency setpoint by way of standard telegram 1.

8.4 Parameter change during operation

Parameter change during operation

A frequency converter which is controlled via fieldbus also handles the transfer of parameters via fieldbus in PROFIdrive mode using data set 47.

The transfer is described in the chapter entitled "Commissioning and Optimization":

- Parameter transfer to the frequency converter
- Parameter transfer from the converter
- Programming error.

See also

Block call (Page 103)

Alarm, fault, and system messages

9

9.1 Fault codes and interrupts

Interrupts

An interrupt does not shut down the frequency converter. The interrupt number is displayed and transferred via STARTER and the fieldbus. Interrupt numbers are stored in parameter r2110 under their code number (e.g., A0503 = 503) and can be read out from here. Interrupts cannot be acknowledged; they will clear of their own accord, provided that the cause has been removed.

Fault codes

In the event of a fault, the converter shuts down and the red "SF" LED lights up. The error code is displayed and transferred via STARTER and the fieldbus.

Fault codes are stored in parameter r0947 under their code number (e.g., F0003 = 3). The associated error value can be found in parameter r0949. If no error value is assigned to a fault, the value 0 is entered. The point in time at which the fault occurred can be read out (r0948), as can the number of the fault code (P0952) that is stored in parameter r0947.

The following sections describe the LED display of fault conditions.

Note

A group fault is only output if it has been enabled via parameter P8452 or the GSD.

Resetting fault codes

To reset the error code, one of the procedures listed below can be used:

- Switch the converter power supply off and on again via the main power supply to the ET 200 station (depending on P1210).
- Set bit 7 in control word 1 (r0054).
- Reset via STARTER.

Description of interrupts and fault codes

For detailed information on alarms and error messages, refer to the *SIMATIC ET 200 List Manual*.

9.2 Diagnostics through LEDs

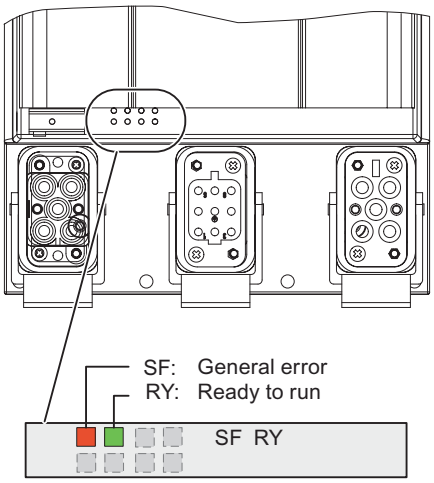
Description

Status LEDs are located on the front panel of the frequency converter

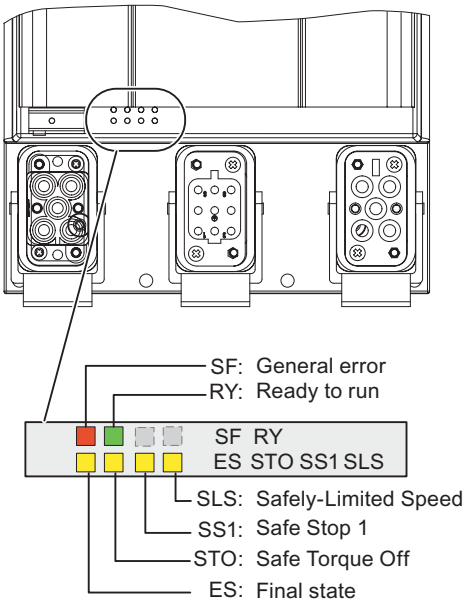
Status display through LEDs

The SIMATIC ET 200pro FC frequency converters have a number of functions and statuses that can be displayed by means of LEDs.

Standard frequency converter



Fail-safe frequency converter



Colors

The frequency converter status is displayed by means of the following range of LED colors and statuses:

Description	Color	Status		
		On	Off	Transitional status (Flashing: 0.5 Hz)
Fault LED • SF	Red			
Standby LED • RY	Green			
Fail-safe LED • ES • STO, SS1, SLS	Yellow			

Description of the LEDs

LEDs	Description
System failure (SF)	The "System failure" LED indicates a general system error in either the software or hardware.
Ready (RY)	The Ready LED indicates whether the converter is ready; a control word is sent for this purpose. It does not show whether the drive is running or not.
Final state (FS)	The "Final state" LED shows whether the final state of a safety function that has been triggered has been reached.
Safe torque off (STO)	The STO LED indicates the safety function "Safe Torque Off".
Safe Stop 1 (SS1)	The SS1 LED indicates the safety function "Safe Stop 1".
Safely Limited Speed (SLS)	The SLS LED indicates the safety function "Safely Limited Speed".

You can find safety function information in the Function Manual.

Standard functions

LEDs		Description
SF	RY/RDY	
Red	Green	
		Ready or running; bus/master connection OK
		Installation
		General fault
		Download from the MMC
		No power supply available

In any state where it makes no difference whether the LED is off, on or flashing, it is listed as "Not relevant".

STO status LEDs for fail-safe functions

LED						Description
SF	RY/RDY	ES	STO	SS1	SLS	
Red	Green	Yellow				
Not relevant	Not relevant			Not relevant	Not relevant	STO parameterized
Not relevant	Not relevant			Not relevant	Not relevant	STO initiated
Not relevant	Not relevant			Not relevant	Not relevant	STO reached
Not relevant	Not relevant					Passivation of frequency converter initiated

SS1 status LEDs for fail-safe functions

LED						Description
SF	RY/RDY	ES	STO	SS1	SLS	
Red	Green	Yellow				
Not relevant	Not relevant					SS1 parameterized
Not relevant	Not relevant		Not relevant		Not relevant	SS1 initiated
Not relevant	Not relevant		Not relevant		Not relevant	SS1 reached

SLS status LEDs for fail-safe functions

LED						Description
SF	RY/RDY	ES	STO	SS1	SLS	
Red	Green	Yellow				
Not relevant	Not relevant					SLS parameterized
Not relevant	Not relevant		Not relevant	Not relevant		SLS initiated
Not relevant	Not relevant		Not relevant	Not relevant		SLS reached

Additional states indicated by LEDs

LED						Description
SF	RY/RDY	ES	STO	SS1	SLS	
Red	Green	Yellow				
						Safety commissioning
						Parameter download from MMC

9.3 Diagnostics through STARTER

In STARTER, fault messages and alarms are presented in the detailed display in the lower part of the workbench. Additional information on each fault message can be called up through the help function.

The frequency converter has an alarm history in which all alarms and fault messages are recorded. You can read out this alarm history in STARTER in ONLINE mode.

9.4 Diagnostics through fieldbus

9.4.1 Diagnostics through the user program

The drive's fault condition is indicated in the cyclic program via status word 1 in bit 3 (ZSW1/bit 3). The PLC program can read this bit and in the event of any faults it can investigate their cause with the help of the function "Reading parameters": Parameter P0944 contains the quantity of active faults and r0947 the fault number (the meaning can be found in the list manual).

Interrupts are displayed in bit 7 of the status word (ZSW1/bit 7). Once this bit has been evaluated, if any interrupts exist their cause can be investigated with the help of the function "Reading parameters". Parameter P2111 contains all pending interrupts and r2110 contains the interrupt numbers, whose meanings can be found in the List Manual.

The user can then initiate suitable action:

- Display
- Reactions in the user program
- Fault acknowledgment via the cyclic program (STW1/bit 7)

The parameters are read in PROFIdrive mode by calling SFC 59.

Note

The fault bit (ZSW1/bit 3) can also be evaluated by means of system diagnostics.

9.4.2 System diagnostics by means of standardized functions

Prerequisites

1. Diagnostics must be set in the interface module; this setting is made in the interface module's property view during configuration.
2. Diagnostics must be set in the frequency converter; this setting is made when the frequency converter is configured by selecting the parameter value "Enable diagnostics" in the frequency converter's property view.

Evaluating

The user program (e.g., SIMATIC S7) has organization blocks OB82, OB86 and OB122 at its disposal for the purpose of evaluating diagnostic errors in the ET 200 station.

- OB82 for diagnostic interrupts on drive errors
- OB86 for diagnostic interrupts for IM slave (ET 200 station failed)
- OB122 for diagnostic interrupts upon I/O access errors.

A specific response to errors can be programmed in these organization blocks. If the OB in question is not available, the control enters a STOP state in the event of an error. The frequency converter's response to the CPU stop is defined by parameter P2040.

Depending on the CPU being used, other organization blocks can be integrated for diagnostics purposes.

If an error occurs in the frequency converter, a diagnosis is reported and OB82 called. Error code 27 is always reported. Detailed error diagnostics is only possible by reading out parameters P0947 to P0949 with SFC59.

9.5 Device diagnostics

Parameter P8820 (1 - 31) contains information about the product version for the current frequency converter which can be read via

- STARTER
- PLC using the "Read parameters" function (PROFIdrive mode)
- PC on the fieldbus using the I&M0 function.

The parameter is assigned as follows:

I&M function	Byte length	Format	Example	Related parameter (Index)
MANUFACTURER_ID	2	U16	42	P8820[5]
ORDER_ID	20	VS	6SL3235-0TEpp-pRB0	P8820[6-15]
SERIAL_NUMBER	16	VS	12345	P8820[16-23]
HARDWARE _REVISION	2	U16	1	P8820[24]
SOFTWARE_REVISION	4	1 Char 3 U8	V123	P8820[25-26]
REVISION_COUNTER	2	U16	0x0001	P8820[27]
PROFILE_ID	2	U16	0x3A00	P8820[28]
PROFILE_SPECIFIC_TYPE	2	U16	0x0003	P8820[29]
IM_VERSION	2	2 U8	11	P8820[30]
IM_SUPPORTED	2	U16	0x0000	P8820[31]

9.6 Fault clearance

Fault clearance depends on locating the cause of the fault exactly. Details of the possible causes of faults and measures for eliminating them can be found in the list manual and in STARTER (using the help function).

Technical data

10

10.1 Technical data

Technical data

You can find general technical data in the manual entitled "SIMATIC ET 200pro Distributed I/O System".

Note

Aside from the general technical data, the following also applies to ET 200pro FC components:

Drop test (in original package) ≤ 0.35 m

Table 10-1 Technical data

Type 6SL3235-…		**0TE21-1RB0**	**0TE21-1SB0**
Construction type		A	A
Cooling type		Convection	Convection
Degree of protection		IP 65	IP 65
Rated input voltage, AC	V	400	400
Permissible voltage range min.	V	380	380
Permissible voltage range max.	V	480	480
Output permissible voltage range			
AC max.	V	480	480
AC min.	V	0	0
Rated output current			
Constant torque	A	2,8	2,8
• With overload (150% for 60 s)	A	4,2	4,2
• With overload (200% for 3 s)	A	5,6	5,6
• Without overload capability	A	3,1	3,1
Rated current I_n			
Peak output current	A	5,6	5,6
Rated input current 3AC			

Type 6SL3235-…		**0TE21-1RB0**	**0TE21-1SB0**
Constant torque	A	1,7	1,7
Rated power	kW	1,1	1,1
	hp	1,5	1,5
With overload (150% for 60 s)	W	1650	1650
With overload (200% for 3 s)	W	2200	2200
Without overload capability	W	1200	1200
Pulse frequency/default setting	Hz	4000	4000
Installation altitude above sea level	m	2000	2000
Efficiency η		95	95
Power factor		0,9	0,9
Modulation depth		0,87	0,87
Width	m	0,155	0,155
Depth	m	0,213	0,213
Height	m	0,23	0,23
Weight	kg	4,0	4,0
Ambient conditions			
Operation	°C	0° to +55°C	0° to +55°C
Relative atmospheric humidity	%	95 (non-condensing)	
Temperature: Transportation, storage	°C	-40 to +70	-40 to +70
Filter (Class A, 3AC)		Integrated	Integrated
Type of overload capability		150% for 60 s every 300 s, 200% for 3 s every 300 s	
Cable cross-section			
Motor cable max.	mm^2	2,5	
EM brake control module			
200 V DC		Integrated	Integrated
Device fusing			
16 A medium time-lag		Integrated	Integrated

Ambient conditions

For information on the mechanical and climatic ambient conditions of the ET 200pro system, please refer to the manual entitled "*SIMATIC ET 200pro Decentralized Peripherals System*".

Special ambient conditions for the ET 200pro FC frequency converter are described in the relevant sections.

10.2 General ambient conditions

The following conditions must be taken into account when installing a frequency converter:

Shocks and vibrations

The frequency converter must not be dropped, exposed to sudden shocks or installed in surroundings where it might be exposed to regular vibrations.

Air pollution/water

The frequency converter must not be installed in areas where there are corrosive gases and air pollution; however, it can be exposed to dust and splashwater (degree of protection IP65).

Installation and cooling

Make sure that convection can take place freely in front of the frequency converter. In this area there must be no devices which could obstruct or affect the convection.

A clearance of 35 mm must be kept above and below the components of the frequency converter from other devices or components in order to ensure that convection can take place unhindered.

11 Dimensional drawings

11.1 Frequency converter

Frequency converter

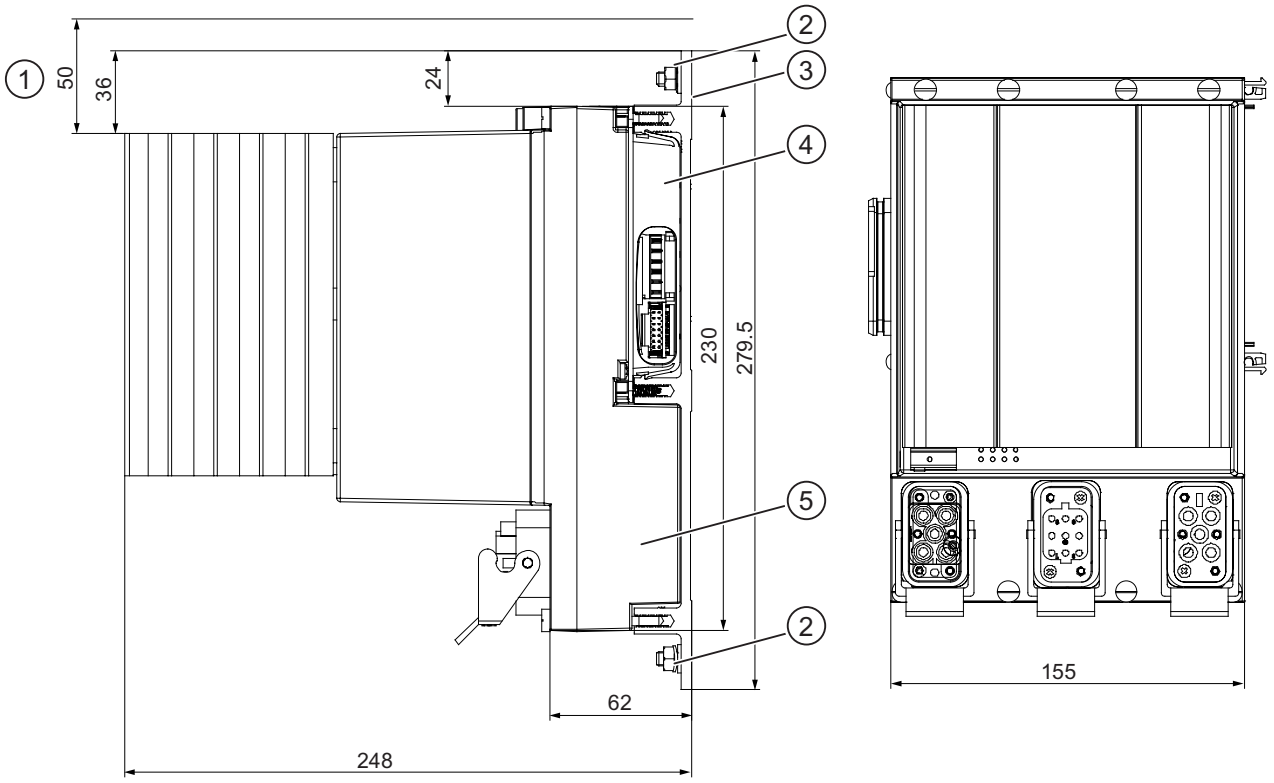


Figure 11-1 Standard frequency converters

① Clearance for heat dissipation
② Earthing point
③ Mounting rail
④ Bus module
⑤ Frequency converter

11.2 Bus module

Bus module

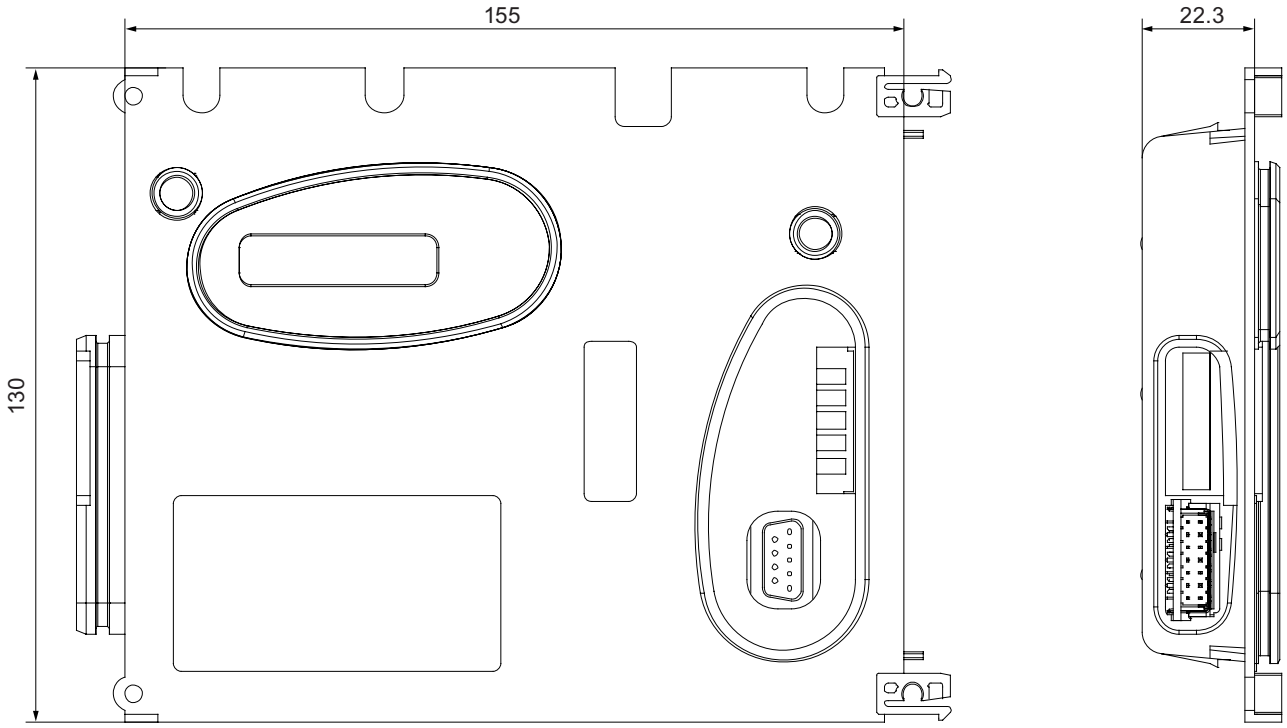


Figure 11-2 Bus module

Spare parts/accessories 12

12.1 Spare parts/accessories

Multi Media Card (MMC)

The Multi Media Card (MMC) is used to save parameters from a control unit. This way it is possible to transfer the saved parameters to another control unit. For a detailed description refer to the section "Operation".

Multi Media Card (MMC)
Order No.
6SL3254-0AM00-0AA0

Optical cable

The optical cable is used to connect a configuring or operating device with an RS232 interface to the optical interface of the frequency converter. Electronics integrated in the cable converts electrical signals of up to 115 kBd into optical signals and vice versa.

Optical cable
Order No.
3RK19 22-2BP00

Motor cable

Prefabricated motor cables up to 10 m long are available ex stock for connecting the motor. Larger lengths up to 15 m can be obtained from our SINAMICS service providers.

Motor cable	
Order No.	Length
6ES7194-1LA01-0AA0	1.5 m
6ES7194-1LB01-0AA0	3.0 m
6ES7194-1LC01-0AA0	5.0 m
6ES7194-1LD01-0AA0	10.0 m

Power jumper connector

Using the power jumper connector it is possible for one frequency converter to loop through up to 25 A from 3AC 400 V to another frequency converter mounted directly alongside. The common fusing of the primary supply is provided externally.

Power jumper connector
Order No.
3RK19 22-2BQ00

Sealing cap for power bus

Unused connections without a sealing cap have a degree of protection of only IP54, with a sealing cap it is IP65.

Sealing caps for power bus	
Order No.	**Quantity**
3RK19 02-0CK00	1
3RK19 02-0CJ00	10

Appendix

A

A.1 Acceptance Log

A.1.1 Documentation of acceptance test

Overview

Acceptance test No.	
Date	
Person carrying-out	

Table A-1 Machine description and overview/block diagram

Designation	
Type	
Serial No.	
Manufacturer	
End customer	
Block/overview diagram of the machine	

Table A-2 Fail-safe functions for each drive

Drive No.	FW version	SI version	Fail-safe function
	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	
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	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	
	r0018 =	r9770 =	

Table A-3 Description of the fail-safe equipment/devices

Drive No.	**Example:** Wiring of the STO terminals (protective door, EMERGENCY STOP), grouping of the STO terminals, etc.

A.1.2 Function test of the acceptance test

Description

The function test must be carried-out separately for each individual drive (assuming that the machine permits this to be done).

Executing the test

First commissioning	Please mark	
Series commissioning		

Function test "Safe Torque Off" (STO)

This test comprises the following steps:

Table A-4 "Safe Torque Off" function (STO)

No.	Description	Status
1.	Initial state • Drive is "Ready to Run" (P0010 = 0) • No safety faults and alarms • r9772.0 = r9772.1 = 0 (STO de-selected and inactive) • P9659 = time intervals for the forced checking procedure correctly set	
2.	Operate the drive	
3.	Check that the expected drive operates	
4.	Select STO while issuing the command to operate	
5.	Check the following: • The drive coasts-down • The drive is braked by the mechanical brake and held if a brake is being used • No safety faults • r9772.0 = r9772.1 = 1 (STO selected and active), r9772.14 = 1 if Safe Brake Control is enabled	
6.	De-select STO	
7.	Check the following: • No safety faults • r9772.0 = r9772.1 = 0 (STO de-selected and inactive) , r9772.14 = 0	
8.	Check that the expected drive operates if so the following is tested: • That the wiring between the control unit and power module is correct • Correct assignment, drive No. – inverter power module – motor • That the hardware is correctly functioning • That the shutdown paths have been correctly wired • Correct assignment of the STO terminals on the control unit • Correct parameterization of the STO function • Routine for the forced checking procedure of the shutdown paths	

Function test "Safe Stop 1" (SS1)

This test comprises the following steps:

Table A-5 "Safe Stop 1" function (SS1)

No.	Description	Status
1.	Initial state • Drive is "Ready to Run" (P0010 = 0) • No safety faults and alarms • r9772.0 = r9772.1 = 0 (STO de-selected and inactive) • r9772.2 = r9772.3 = 0 (SS1 de-selected and inactive)	
2.	Operate the drive	
3.	Check that the expected drive operates	
4.	Select SS1 while issuing the traversing command	
5.	Check the following: • Drive speed decreases corresponding to the selected ramp time (if required, use a stop watch) • After the parameterized minimum speed has been fallen below, the drive coasts-down • The drive is braked and held by the mechanical brake if a brake is being used • No safety faults • r9772.1 = 1 (STO active) • r9772.2 = 1 (SS1 selected) • r9772.14 = 1 if safe brake monitoring is enabled	
6.	De-select SS1	
7.	Check the following: • No safety faults • r9772.1 = 0 (STO inactive) • r9772.2 = 0 (SS1 de-selected) • r9772.14 = 0	
8.	Check that the expected drive operates if so the following is tested: • The wiring between the control unit and power module is correct • Correct assignment, drive No. – inverter power module – motor • Correct functioning of the hardware • Correct wiring of the shutdown paths • Correct assignment, STO terminals on the control unit • Correct parameterization of the SS1 function	

Function test "Safely-Limited Speed" (SLS)

This test comprises the following steps:

Table A-6 "Safely-Limited Speed" function (SLS)

No.	Description	Status
1.	Initial state • Drive is "Ready to Run" (P0010 = 0) • No safety faults and alarms • r9772.4 = r9772.5 = 0 (SLS de-selected and inactive)	
2.	Operate the drive (if the machine permits it, at a higher speed than the parameterized safely-limited speed)	
3.	Check that the expected drive operates	
4.	Select SLS while issuing the traversing command	
5.	Check the following: • r9772.4 = 1 (SLS selected) • Drive speed decreases corresponding to the selected ramp time or SLS mode (if required, use an oscilloscope) • After the parameterized safely-limited speed has been fallen below, the speed remains below this limit – In SLS mode 1 à correct, must be no fault – In SLS mode 0 à LSTO (safety fault at ramping end) – In SLS mode 2 à LSTO (immediately) • r9772.5 = 1 (SLS active)	
6.	De-select SLS	
7.	Check the following: • No safety faults • r9772.4 = r9772.5 = 0 (SLS de-selected and inactive)	
8.	Check that the expected drive operates if so the following is tested: • The wiring between the control unit and power module is correct • Correct assignment, drive No. – inverter power module – motor • Correct functioning of the hardware • Correct wiring of the shutdown paths • Correct parameterization of the SLS function	

A.1.3 Completing the acceptance log

Parameters of the fail-safe functions

	Specified value checked?	
	Yes	No
Control unit		

Checksums

Drive		Checksums	
Name	Drive No.	Control unit (r9798)	Control unit (r9898)

Data back-up/archiving

	Memory medium			Saved where
	Type	Designation	Date	
Parameters				
PLC program				
Circuit diagrams				

Signatures

Commissioning engineer

Confirms that the above listed tests and checks have been correctly carried-out.

Date	Name	Company/department	Signature

Machinery construction OEM

Confirms the correctness of the parameterization documented above.

Date	Name	Company/department	Signature

A.2 ESD directives

A.2.1 Electromagnetic compatibility

Electromagnetic compatibility (EMC)

All manufacturers/assemblers of electrical units which "perform an essentially complete function and are marketed as a single unit designed for the end-user", must comply with the EMC Directive 89/336/EEC.

There are three ways for the manufacturer/assembler to verify compliance:

Self-certification

The manufacturer declares that the European standards applicable to the electrical environment for which the unit is intended are satisfied. Only standards which have been officially published in the official journal of the European Union are allowed to be cited in the manufacturer's declaration.

Description of technical design

A description of the unit's technical design covering its EMC properties may be drawn up. Such a description must be approved by a "competent body" appointed by the responsible European authority. This method enables the use of standards which are still being prepared.

EMC standards

The drives were tested according to the EMC product standard EN 61800-3:2004.

A.2.2 Definition of EMC environment and EMC classes

Classification of EMC behavior

The EMC environment and the EMC classes are defined in the EMC product standard EN 61800-3 as follows:

Environment 1

An environment in which there are residential estates and facilities which are connected directly to a public low-voltage supply network without the use of an intermediate transformer.

Note

Example: Houses, apartments, commercial units or office rooms within a residential building.

Environment 2

An environment in which there are commercial estates and facilities which are not connected directly to a public low-voltage supply network.

Note

Example: Developed commercial sites and other sites which are supplied by a transformer provided specially for the purpose.

Class C1

Power drive system (PDS) with a rated voltage of less than 1000 V for use in residential buildings.

Class C2

Power drive system (PDS) with a rated voltage of less than 1000 V, which is neither fitted with a plug connector nor intended for (easy) transport and which, when used in residential buildings, is designed solely for installation and commissioning by a specialist.

Note

A specialist is a person or organization with the necessary skills to install and/or commission a power drive system (PDS) including its EMC aspects.

A.2.3 Overall behavior as regards EMC

EMC emitted interference

The frequency converters were tested in accordance with the requirements regarding emitted interference for environments of Class C3 (commercial).

Table A-7 Conductor-related and radiated emitted interference

EMC impact	Standard	Step
Conducted emissions	EN 55011	Class A
Radiated emissions	EN 55011	Class A

Note

To comply with this behavior, the factory-set switching frequency must not be exceeded.

Harmonic currents

No connection approval is required for units which are installed in an environment of Class C3 (commercial).

EMC immunity

The frequency converters were tested in accordance with the interference immunity requirements for environments of Class C3 (commercial).

Table A-8 EMC immunity

EMC impact	Standard	Step	Power criterion
Electrostatic discharge (ESD)	EN 61000-4-2	4 kV discharge by contact	A
		8 kV discharge in air	
Electromagnetic high frequency field	EN 61000-4-3	0.15 MHz … 80 MHz 10 V/m	A
Amplitude modulated		80 % AM at 1 kHz	
Transient overvoltages	EN 61000-4-4	2 kV at 5 kHz	A
Voltage surge	EN 61000-4-5	1 kV inverse mode (L-L)	A
1.2/50 µs		2 kV common mode (L-E)	
Wired	EN 61000-4-6	0.15 MHz … 80 MHz 10 V/rms	A
High frequency common mode		80 % AM at 1 kHz	
System interruptions and voltage dips	EN 61000-2-1	100 % voltage dip for 3 ms	C
		30 % voltage dip for 10 ms	B
		60 % voltage dip for 100 ms	C
		95 % voltage dip for 5000 ms	C
Voltage distortion	EN 61000-2-4 Class 3	10 % THD	A
Voltage asymmetry	EN 61000-2-4 Class 3	3 % inverse reactance	A
Frequency fluctuation	EN 61000-2-4 Class 3	Rated value 50 Hz or 60 Hz (± 4 %)	A
Commutation notches	EN 60146-1-1 Class B	Depth = 40 %	A
		Area = 250 % x degrees	

A.2.4 ET 200S FC frequency converter in the industrial environment

ET 200pro FC frequency converters with integrated Class A EMC filters are designed for use in an industrial environment, provided that the permissible cable lengths are used.

Table A-9 Use in the industrial environment

Fields of application	Requirement for	
	Emitted noise	Interference immunity
Industry	EN 61000-6-4, with Class A filter	EN 61000-6-2

Installation guideline for ET 200pro FC frequency converter with integrated EMC filter

- Operation is only permitted for TN line supply systems.
- The converter must be assembled on a grounded plate with a large surface.
- The module rack is to be grounded.
- The maximum length per frequency converter of the shielded power cable is 15 m.

A.2.4.1 ET 200pro FC frequency converter in a drive system in accordance with EN 61800-3

Explanatory notes for EN 61800-3+A11

The EN 61800-3+A11 product standard for "Adjustable speed electrical power drive systems, Part 3: EMC requirements and specific test methods" specifies limit values for noise radiation and interference immunity. The EMC product standard EN 61800-3+A11 does not apply directly to a frequency converter but to a complete drive system, which comprises the complete circuitry, motor and cables in addition to the converter.

Limit values for compliance with EN 61800-3 Category C3

The following table lists the key limit values for compliance with EN 61800-3 on devices with **restricted availability** for a drive system in accordance with Category C3 (Category C3: Drive system (PDS) with a rated voltage of < 1000 V. For use in a second environment), i.e., **use in second environment** (industrial) with commissioning and installation carried out by an EMC expert.

Table A-10 Limit values for noise radiation for a drive system compliant with Category C3

EMC phenomena	Basic standard for test procedures	Limit value
Radiated emissions	EN 55011	Class A, Group 1
Conducted emissions	EN 55011	Class A, Group 2

Table A-11 Limit values for interference immunity for a drive system compliant with Category C3

EMC phenomena		Basic standard for test procedures	Level				Evaluation criterion
Voltage dips		EN 61800-3-A11	30 %, 10 ms 1)				B
			60 %, 100 ms 1)				C
			95 %, 5 s 2)				C
Voltage interruptions		EN 61800-3-A11	100 %, 230 ms 2)				C
			100 %, 120 ms (regenerative feedback) 3)				C
Harmonics at rated load			5.	7.	11.	13.	--
	Motor operation	EN 61800-3-A11	18,4%	15,6%	8,8%	8,4%	
	Regenerative feedback	EN 61800-3-A11	20,3%	18,4%	9,8%	9,3%	
Electrostatic discharge		EN 61000-4-2	8 kV, air discharge (housing)				B
Interference pulses	Burst	EN 61000-4-4	2 kV/5 kHz (electric power cable)				B
	Voltage surge	EN 61000-4-5	2 kV, phase – ground (electric power cable)				B
			1 kV, phase – phase (electric power cable)				B
High-frequency electromagnetic field, amplitude-modulated		EN 61000-4-3	80 MHz – 1000 MHz, 10 V/m, 80 % AM				A
Ground leakage current		EN 61800-5-1	See the two tables below.				--

1) Reduction of motor speed
2) Shutdown on fault F00003 "Undervoltage"
3) Shutdown on fault F00002 "Overvoltage"

The requirements of the product standard for a drive system, according to C3, are fulfilled.

Operation with unshielded cable is not permitted.

Table A-12 Ground leakage currents to EN 61800-5-1 with 15 m CY shielded cable

Motor frequency	Ground leakage currents (mA) at pulse frequency		
Hz	4 kHz	8 kHz	12 kHz
50	1,95	1,39	1,19
20	2,58	1,73	1,37
10	2,70	1,78	1,40
5	2,74	1,79	1,40
Standby	0,53		

A.2.4.2 ET 200pro FC frequency converter in general industrial application

Explanatory notes for general industrial application

In this EMC application, the manufacturer/assembler must certify the devices used as compliant with the EMC directive for industrial environments. The limit values are in line with the generic standards EN 61000-6-4 for generic emissions (noise radiation) and EN 61000-6-2 interference immunity in the second environment (industrial).

Limit values for general industrial application

The following tables contain the key limit values for compliance with the generic standards.

Table A-13 Limit values for noise radiation for general industrial application to EN 61000-6-4

EMC phenomena	Basic standard for test procedures	Limit value
Radiated emissions	EN 55011	Class A, Group 1
Conducted emissions	EN 55011	Class A, Group 1

Table A-14 Limit values for interference immunity for general industrial application to EN 61000-6-2

EMC phenomena		Basic standard for test procedures	Level	Evaluation criterion
Voltage dips		EN 61000-4-11	30% reduction, 0.5 periods	B
Voltage interruptions		EN 61000-4-11	> 95% reduction, 250 periods	C
Electrostatic discharge		EN 61000-4-2	8 kV, air discharge	B
			4 kV, contact discharge	B
Interference pulses	Burst	EN 61000-4-4	2 kV electric power cable	B
			1 kV control cable	B
	Voltage surge	EN 61000-4-5	2 kV electric power cable (phase - ground)	B
			1 kV electric power cable (phase - phase)	B
			1 kV control cable (cable - ground)	B
High-frequency electromagnetic field, amplitude-modulated		EN 61000-4-3	80 MHz – 1000 MHz, 10 V/m, 80 % AM	A

The requirements of the generic standards in respect of interference immunity are met. The required values for interference emission are complied with if installation takes place according to EMC installation guidelines.

A.3 Standards

Standards and directives

CE	**European Low-Voltage Directive** The SINAMICS product series meets the requirements of the Low Voltage Directive 73/23/EEC, including the amendment by Directive 98/68/EEC. The devices are certified as complying with the following standards: EN 61800-5-1 - Semiconductor - General Requirements and Line Commutated Converters EN 60204-1 - Safety of Machinery - Electrical Equipment of Machinery
	European Machinery Directive The converter series does not fall within the area covered by the machinery directive. However, the use of the products in a typical machine application has been fully assessed for compliance with the main regulations in this directive concerning health and safety. A declaration regarding the general acceptance is available upon request.
	European EMC Directive When installed in accordance with the recommendations specified in this manual, the frequency converter complies with all regulations of the EMC directive according to the definition provided by EN 61800-3 "EMC Product Standard for Power Drive Systems".
c UL us LISTED	**Underwriters Laboratories** The device is listed by UL and CUL for power conversion in an environment the pollution degree 2. Comment: UL certification is being processed. **National Fire Protection Association (NFPA) compatibility** Due to their design features, it is possible that these devices cannot be installed in accordance with the National Electrical Code (NFPA70). These devices are only certified for installation in industrial machines in accordance with the "Electrical Standard for Industrial Machinery" (NFPA79).
	ISO 9001 Siemens AG uses a quality management system that meets the requirements of ISO 9001.
	EC Machinery Directive 98/37/EG This directive defines basic protection goals for safety technology
	EN 292-1 Basic terminology and general principles for design
	EN 954-1 Safety-related parts of control systems
	EN 1050 Risk assessment
	DKE 226.03 Safety-related functions of electrical drive systems in machinery
	EN 61800-3 EMC product standard including special test procedures
	EN 61800-5-1 Requirements for the safety of electrical power drive systems with adjustable speed
	IEC 61508 Functional safety of electrical and electronic systems

List of abbreviations/acronyms

B

B.1 Abbreviations

Abbreviations

Abbreviations	German	English
A		
A...	Warnung	alarm
AC	Wechselstrom	alternating current
AD	Analog-Digital-Konverter	analog digital converter
ADC	Analog-Digital-Konverter	analog digital converter
ADR	Adresse	address
AFM	Frequenzmodifikation	frequency modification
AFM	Zusätzliche Frequenzmodulation	additional frequency modulation
AG	Automatisierungsgerät	programmable controller
AI	Analog-Eingang	analog input
AIN	Analog-Eingang	analog input
AK	Anforderungsidentifizierung	request identification
ALM	Active Line Module	active line module
AO	Analog output	analog output
AOP	Advanced Operator Panel	advanced operator panel
AOUT	Analog-Ausgang	analog output
APC	Advanced Positioning Control	advanced positioning control
ASC	Ankerkurzschluss	armature short-circuit
ASCII	Amerikanische Code-Norm für den Informationsaustausch	American standard code for information interchange
ASIC	Anwendungsspezifischer integrierter Schaltkreis	application specific integrated circuit
ASM	Asynchronmotor	induction motor
ASP	Analog-Sollwert	analog setpoint
ASVM	Asymmetrische Raumvektormodulation	asymmetrical space vector modulation
B		
BB	Betriebsbedingung	operating condition
BCC	Block-Prüfzeichen	unit mark of conformity
BCD	Binär codierter Dezimalcode	binary conversion code

Abbreviations	German	English
BERO	Firmenname für einen Näherungsschalter	trade name for a type of proximity switch
BI	Binektor-Eingang	binector input
BIA	Berufsgenossenschaftliches Institut für Arbeitssicherheit	German institute for occupational safety
BICO	Binektor-Konnektor-Technologie	binector connector technology
BIST	Testprogramm	debugger
BLM	Basic Line Module	basic line module
BO	Binektor-Ausgang	binector output
BOP	Basic Operator Panel	basic operator panel
C		
C	Kapazität	capacitance
C...	Safety-Meldung	safety message
CAN	Serielles Bussystem	controller area network
CB	Kommunikationsbaugruppe	communication board
CBC	Kommunikationsbaugruppe CAN	communication board CAN
CCW	gegen den Uhrzeigersinn	counter-clockwise
CD	Compact Disc	compact disc
CDS	Befehlsdatensatz	command data set
CI	Konnektor-Eingang	connector input
CM	Konfigurierungs-Management	configuration management
CMD	Befehl	command
CNC	Computerunterstützte numerische Steuerung	computer numerical control
CO	Konnektor-Ausgang	connector output
CO/BO	Konnektor-Ausgang/Binektor-Ausgang	connector output/binector output
COB-ID	CAN Object-Identification	can object-identification
COM	Mittelkontakt eines Wechslerkontaktes	common contact of a change-over relay
CP	Kommunikationsprozessor	communications processor
CPU	Zentralbaugruppe	central processing unit
CRC	Checksummenprüfung	cyclic redundancy check
CSM	Control Supply Module	control supply module
CT	Konstantes Drehmoment; hohe Überlast	constant torque
CU	Control Unit	Control Unit
CW	im Uhrzeigersinn	clockwise
D		
DA	Digital-Analog-Konverter	digital analog converter
DAC	Digital-Analog-Konverter	digital analog converter
DC	Gleichstrom	direct current
DCN	Gleichstrom negativ	direct current negative
DCP	Gleichstrom positiv	direct current positive
DDS	Antriebsdatensatz	drive data set
DI, DIN	Digital-Eingang	digital input

Abbreviations	German	English
DI/DO	Digitaleingang/-ausgang bidirektional	bidirectional digital input/output
DIP	DIP-Schalter	dip switch
DMC	DRIVE-CLiQ Module Cabinet (Hub)	drive-cliq module cabinet (hub)
DO	Digital-Ausgang	digital output
DOUT	Digital-Ausgang	digital output
DP	Dezentrale Peripherie (verteilte E/As)	decentralized peripherals
DPRAM	Speicher mit beidseitigem Zugriff	dual ported random access memory
DRAM	Dynamischer Speicher	dynamic random access memory
DRIVE-CLiQ	Drive Component Link with IQ	drive component link with iq
DS	Antriebs-Zustand	drive state
DSC	Dynamic Servo Control	dynamic servo control
E		
ECD	Ersatzschaltbild	equivalent circuit diagram
EDS	Geberdatensatz	encoder data set
EEC	Europäische Wirtschaftsgemeinschaft	European economy community
EEPROM	Elektrisch löschbarer, programmierbarer Festwertspeicher	erasable programmable read-only memory
EGB	Elektrostatisch gefährdete Baugruppen	electrostatic sensitive devices (esd)
ELCB	Erdschluss-Schutzschalter; Fehlerstrom-Schutzschalter (FI)	earth leakage circuit-breaker
ELP	Erdschlussüberwachung	earth leakage protection
EMC	Elektromagnetische Verträglichkeit (EMV)	electromagnetic compatibility
EMI	Elektomagnetische Störung	electromagnetic interference
EMF	Elektromagnetische Kraft	electromagnetic force (EMF)
EMK	Elektromagnetische Kraft	electromagnetic force (EMF)
EMV	Elektromagnetische Verträglichkeit	electromagnetic compatibility (EMC)
EN	Europäische Norm	European standard
EnDat	Geber-Schnittstelle	encoder-data-interface
EP	Impulsfreigabe	enable pulses
EPOS	Einfachpositionierer	basic positioner
ES	Technisches System	engineering system
ESB	Ersatzschaltbild	equivalent circuit diagram
ESR	Erweitertes Stillsetzen und Rückziehen	extended stop and retract
F		
F...	Störung	fault
FAQ	Häufig gestellte Fragen	frequently asked questions
FCC	Flussstromregelung	flux current control
FCC	Steuerfunktionsablauf	function control chart
FCL	Schnelle Strombegrenzung	fast current limiting
FEM	Fremderregter Synchronmotor	separately excited synchronous motor
FEPROM	Schreib- und Lesespeicher nichtflüchtig	flash eprom
FF	Festfrequenz	fixed frequency

Abbreviations	German	English
FFB	Freier Funktionsbaustein	free function block
FG	Funktionsgenerator	function generator
FI	Fehlerstrom-Schutzschalter	earth leakage circuit-breaker (elcb)
FOC	Feldorientierte Regelung	field-oriented control
FP	Funktionsplan	function diagram
FREQ	Frequenz	frequency
FSA	Baugröße A	frame size A
FSB	Baugröße B	frame size B
FSC	Baugröße C	frame size C
FSD	Baugröße D	frame size D
FSE	Baugröße E	frame size E
FSF	Baugröße F	frame size F
FW	Firmware	firmware
G		
GB	Gigabyte	gigabyte
GC	Global-Control-Telegramm (Broadcast-Telegramm)	global control telegram (broadcast telegram)
GSD	Gerätestammdatei: beschreibt die Merkmale eines PROFIBUS-Slaves	device master file: describes the features of a profibus slave
GSG	Inbetriebnahme-Anleitung	getting started guide
GSV	Gate Supply Voltage	gate supply voltage
GUI ID	Eindeutige globale Kennung	graphical user interface
H		
HF	Hochfrequenz	high frequency
HFD	Hochfrequenzdrossel	high frequency reactor
HIW	Haupt-Istwert	main actual value
HLG	Hochlaufgeber	ramp-function generator
HMI	Mensch-Maschine-Schnittstelle	human machine interface
HO	Konstantes Drehmoment; hohe Überlast	constant torque
HSW	Haupt-Sollwert	main setpoint
HTL	Logik mit hoher Störschwelle, Hochspannungs-Transistor-Logik	high-threshold logic
HW	Hardware	hardware
I		
i. V.	In Vorbereitung: diese Eigenschaft steht zur Zeit nicht zur Verfügung	in preparation: this feature is currently not available
I/O	Eingang/Ausgang	input/output
IBN	Inbetriebnahme	commissioning
ID	Identifizierung	identifier
IEC	Internationale Norm in der Elektrotechnik	international electrotechnical commission
IGBT	Bipolartransistor mit isolierter Steuerelektrode	insulated gate bipolar transistor
IL	Impulslöschung	pulse suppression

Abbreviations	German	English
IND	Unter-Index	sub index
IP65	Schutzgrad 65	grade of protection 65
IT	Drehstromversorgungsnetz ungeerdet	Insulated three-phase supply network
IVP	Interner Spannungsschutz	internal voltage protection
J		
JOG	Tippen, JOG-Betrieb	jogging
K		
KDV	Kreuzweiser Datenvergleich	data cross-checking
KIB	Kinetische Pufferung	
KIP	Kinetische Pufferung	kinetic buffering
Kp	Proportionalverstärkung	proportional gain
KTY	Spezieller Temperatursensor	special temperature sensor
L		
L	Induktivität	inductance
LCD	Flüssigkristallanzeige	liquid-crystal display
LED	Leuchtdiode	light emitting diode
LGE	Länge	length
LIN	Linearmotor	linear motor
LO	Leichte Überlast (Veränderbares Drehmoment)	light overload
LR	Lageregler	position controller
LSB	Niederstwertiges Bit	least significant bit
LSS	Netzschalter	line side switch
LU	Längeneinheit	length unit
LWL	Lichtwellenleiter	optical fibre
M		
M	Masse	reference potential, zero potential
MB	Megabyte	megabyte
MCC	Motion Control Chart	motion control chart
MDS	Motordatensatz	motor data set
MHB	Motor-Haltebremse	motor holding brake
MLFB	Maschinenlesbare Fabrikatebezeichnung	machine-readable product designation
MLP	Mehrsprachen-Paket	multi language package
MMC	Mensch-Maschine-Kommunikation	man-machine communication
MMC	Micro Memory Card kompakte Speicherkarte für SIMATIC	Micro Memory Card Compact memory card for SIMATIC
MOP	Motorpotentiometer	motor potentiometer
MSB	Höchstwertiges Bit	most significant bit
MSCY_C1	Zyklische Kommunikation zwischen Master (Klasse 1) und Slave	master slave cycle class 1
MT	Messtaster	measuring probe
N		

Abbreviations	German	English
N. C.	Nicht angeschlossen	not connected
N...	Keine Meldung oder Interne Meldung	no report
NAMUR	Normenarbeitsgemeinschaft für Mess- und Regeltechnik in der chemischen Industrie	standardization association for measurement and control in chemical industries
NC	Numerische Steuerung	numerical control
NC	Ruhekontakt; Öffner	normally closed (contact)
NEMA	Normengremium in USA (United States of America)	national electrical manufacturers association
NM	Nullmarke	zero mark
NO	Arbeitskontakt; Schließer	normally open (contact)
NPN	Negativ positiv negativ	negative positive negative
O		
OA	Open Architecture	open architecture
OEM	Original Equipment Manufacturer	original equipment manufacturer
OLM	Optische Koppelbaugruppe	
OLP	Stecker für optische Verbindung	optical link plug
OMI	Option Module Interface	option module interface
OP	Bedienfeld	operator panel
OPI	Betriebsanleitung	operating instruction
P		
P...	Einstellparameter	adjustable parameter
PcCtrl	Steuerungshoheit	master control
PDS	Leistungsteildatensatz, Antriebssystem	power unit data set
PE	Schutzerde	protective earth
PELV	Schutzkleinspannung	protective extra low voltage
PEM	Permanenterregter Synchronmotor	permanent-magnet synchronous motor
PG	Programmiergerät	programming terminal
PI	Proportional Integral	proportional integral
PID	Proportional Integral Differential	proportional integral differential
PID	Proportional-Integral-Differential-Regler	proportional integral differential controller
PKE	Parameterkennung	parameter ID
PKW	Parameterkennung Wert	parameter ID value
PLC	Speicherprogrammierbare Steuerung (SPS)	programmable logical controller (PLC)
PLI	Listenhandbuch	parameter list
PLL	Baustein zur Synchronisierung	phase locked loop
PM	Netzteil	power module
PM-IF	Leistungsteil Schnittstelle	power module interface
PNO	PROFIBUS Nutzerorganisation	profibus user organisation
PNP	Positiv negativ positiv	positive negative positive
PNU	Parameternummer	parameter number
POT	Potentiometer	potentiometer

Abbreviations	German	English
PPI	Punkt zu Punkt Schnittstelle	point to point interface
PPO	Parameter-Prozessdatenobjekt	parameter process data object
PRBS	Weißes Rauschen	pseudo random binary signal
PROFIBUS	Serieller Datenbus	process field bus
PROFIdrive	Antriebsstandard	drive standard
PROFINET	Serieller Datenbus	process field network
PS	Stromversorgung	power supply
PSA	Power Stack Adapter	power stack adapter
PTC	Positiver Temperaturkoeffizient	positive temperature coefficient
PTP	Punkt zu Punkt	point to point
PWE	Parameterwert	parameter value
PWM	Pulsweitenmodulation	pulse width modulation
PX	Leistungserweiterung	power extension
PZD	PROFIBUS Prozessdaten	profibus process data
Q		
QC	Schnellinbetriebnahme	quick commissioning
R		
r...	Beobachtungsparameter (nur lesbar)	display parameter (read only)
RAM	Speicher zum Lesen und Schreiben	random access memory
RCCB	Fehlerstrom-Schutzschalter	residual current circuit-breaker
RCD	Fehlerstrom-Schutzschalter	residual current device
RFG	Hochlaufgeber	ramp-function generator
RFI	Hochfrequenzstörung	radio frequency interference
RJ45	Norm. Beschreibt eine 8-polige Steckverbindung mit Twisted-Pair Ethernet.	standard. Describes an 8-pole plug connector with twisted pair ethernet.
RKA	Rückkühlanlage	recooling system
RO	Nur lesbar	read only
ROM	Festwertspeicher	read-only memory
RPDO	Receive Process Data Object	receive process data object
RPM	Umdrehungen pro Minute	revolutions per minute
RS232	Serielle Schnittstelle	serial interface
RS485	Norm. Beschreibt die Physik einer digitalen seriellen Schnittstelle.	standard. Describes the physical characteristics of a digital serial interface.
RTC	Echtzeituhr	real time clock
RTOS	Echtzeitbetriebssystem	real time operating system
S		
S1	Dauerbetrieb	continuous operation
S3	Aussetzbetrieb	periodic duty
SBC	Sichere Bremsenansteuerung	safe brake control
SBH	Sicherer Betriebshalt	safe operating stop
SBR	Sichere Bremsrampe	safe braking ramp

Abbreviations	German	English
SBT	Sicherer Bremsentest	safe brake test
SCL	Skalierung	scale
SDI	Sichere Richtung	safe direction
SDP	Statusanzeigeeinheit	staus display unit
SE	Sicherer Software-Endschalter	safe software limit switch
SFC	Systemfunktion	System function
SG	Sicher reduzierte Geschwindigkeit	safely reduced speed
SGA	Sicherheitsgerichteter Ausgang	safety-related output
SGE	Sicherheitsgerichteter Eingang	safety-related input
SH	Sicherer Halt	safe standstill
SI	Safety Integrated	safety integrated
SIL	Sicherheitsintegritätsgrad	safety integrity level
SLI	Sicheres Schrittmaß	safely limited increment
SLM	Smart Line Module	smart line module
SLP	Sichere Endlage	safely limited position
SLS	Sicher begrenzte Geschwindigkeit	safely limited speed
SLVC	Geberlose Vektorregelung	sensorless vector control
SM	Sensor Module	sensor module
SMC	Sensor Module Cabinet	sensor module cabinet
SME	Sensor Module External	sensor module external
SN	Sicherer Software-Nocken	safe software cam
SOL	Serielle Verbindung als Option	serial option link
SOS	Sicherer Betriebshalt	safe operational stop
SPC	Sollwertkanal	setpoint channel
SPS	Speicherprogrammierbare Steuerung	programmable logic controller (plc)
SS1	Sicherer Stopp 1	safe stop 1
SSI	Synchron Serielle Schnittstelle	synchronous serial interface
SSM	Sichere Geschwindigkeitsanzeige n < nx	safe speed monitoring n < nx
SSR	Sichere Bremsrampe	safe stop ramp
STO	Sicher abgeschaltetes Moment	safe torque off
STW	PROFIBUS Steuerwort	profibus control byte
STW	Steuerwort	control word
STX	Textanfang	text start
SVM	Raumvektormodulation	space vector modulation
T		
TB	Terminal Board	terminal board
TIA	Totally Integrated Automation	totally integrated automation
TM	Terminal Module	terminal module
TN	Drehstromversorgungsnetz geerdet	grounded three-phase supply network
Tn	Nachstellzeit	integral time
TPDO	Transmit Process Data Object	transmit process data object
TT	Drehstromversorgungsnetz geerdet	grounded three-phase supply network

Abbreviations	German	English
TTL	Transistor-Transistor-Logik	transistor-transistor-logic
U		
U/f	Spannung/Frequenz	voltage/frequency
UL	Underwriters Laboratories Inc.	underwriters laboratories inc.
USS	Universelle serielle Schnittstelle	universal serial interface
USV	Unterbrechungsfreie Stromversorgung	uninterruptible power supply
V		
VC	Vektorregelung	vector control
Vdc	Zwischenkreisspannung	dc link voltage
VdcN	Teilzwischenkreisspannung negativ	partial dc link voltage negative
VdcP	Teilzwischenkreisspannung positiv	partial dc link voltage positive
VDE	Verband Deutscher Elektrotechniker	association of german electrical engineers
VDI	Verein Deutscher Ingenieure	association of german engineers
Vpp	Volt Spitze zu Spitze	volt peak to peak
VSM	Voltage Sensing Module	voltage sensing module
VT	Variables Drehmoment	variable torque
W		
WEA	Wiedereinschaltautomatik	automatic restart
WZM	Werkzeugmaschine	machine tool
X		
XML	Erweiterbare Auszeichnungssprache (Standardsprache für Web-Publishing und Dokumentenmanagement)	extensible markup language
Z		
ZK	Zwischenkreis	dc link
ZSW	PROFIBUS Zustandswort	profibus status byte
ZSW	Zustandswort	status byte
ZUSW	Zusatz-Sollwert	supplementary setpoint

Glossary

Duty cycle

Electrical machines run in one of the modes of operation described below. This results in the machine being subjected to different thermal loads during a duty cycle (S1 to S9).

- S1: Continuous operation
- S2: Short-time operation
- S3: Intermittent operation without startup procedure
- S4: Intermittent operation with startup procedure
- S5: Intermittent operation with startup procedure and electrical braking
- S6: Continuous operation with intermittent load
- S7: Uninterrupted operation (with startup and electrical braking)
- S8: Uninterrupted operation with periodic speed variations
- S9: Uninterrupted operation with non-periodic load and speed variations

ET 200pro Distributed I/O System

The ET 200pro distributed I/O system is a highly modular and very flexible DP slave with IP65 degree of protection.

The interface to the fieldbus is always provided by an IM 151 interface module. Implementations vary from one application to the next.

Expectations

The monitoring functions in each monitoring channel work on the principle that a defined status must prevail before each action is carried out and a specific acknowledgement must follow each action. If these expectations of a monitoring channel are not fulfilled, the drive coasts to a standstill (two-channel) and an appropriate message is output.

General installation guidelines

Safety-related motor starters and frequency converters can be operated in tandem downstream of a module able to switch safe switch-off signals on the ET200 backplane bus. The F switch supplies two switch-off signals, F0 and F1; the repair switch module F-RSM only supplies F0.

The STARTER software can be used to assign switch-off signals at will if a different application ID is selected for the frequency converters.

Load groups

A load group contains a frequency converter with a power supply and all the frequency converters located to the right of it as far as the next frequency converter/motor starter with a power supply.
All ET 200pro FCs sharing one incoming power bus supply are referred to as a "load group". A load group can differ from a potential group. An additional incoming power bus supply may be needed within a group of frequency converters supplied by the same power module, in order to avoid exceeding the rated operational current (aggregate current) of the terminal modules. The aggregate current of the power bus must not exceed 50 A.

Monitoring cycle

The safety-related monitoring functions for the drives are executed cyclically in ms.

Monitoring parameters

Parameters which can only be monitored are identified by the prefix "r".

These parameters are used to display internal variables, e.g., statuses or actual values.

Examples of notation:

r0002	Monitoring parameter 2
r0052.3	Monitoring parameter 52, bit 03
r0947[2]	Monitoring parameter 947 index 2
r0964[0 ... 4]	Monitoring parameter 964 with 5 indices (indices 0 to 4)

Parameter attributes

In the parameter list, the header for each parameter shows all attributes and groups associated with it.

Index

The index is used to define a parameter (e.g., P0013[20]) with a number of following elements (in this case, 20). Each individual index is defined using a numerical value. In relation to a parameter, this means that one indexed parameter can exhibit a number of values. The values are addressed using the parameter number and index value (e.g. P0013[0], P0013[1], P0013[2], P0013[3], P0013[4]). Indexed parameters are used, for example, for:

- Drive data sets (DDS)
- Command data sets (CDS)
- Subfunctions

BICO

The following types of interconnectable parameter are available. The function manual contains a description of the BICO technology.

Table 12-15 BICO parameter attributes

BICO	Description
BI	Binector input
BO	Binector output
CI	Connector input
CO	Connector output
CO/BO	Connector output/Binector output

Changeable in

"P" parameters can only be changed dependent upon the status of the frequency converter. The parameter value will not be applied unless the current status is listed in the "changeable" parameter attribute. For example, the parameter for quick commissioning P0010 with the attribute "CT" can only be changed in quick commissioning "C" or standby status "T" and not in motor mode "U".

Table 12-16 Changeable parameter attributes

Status	Description
C	Quick commissioning
U	Running (drive running)
T	Drive ready to start

Data types

The data type associated with a parameter defines the widest possible range of values. Five data types are used on the frequency converter. They represent either an unsigned integer value (U16, U32) or a floating point value. The range of values is frequently limited by a minimum and a maximum value (min., max.) or using variables associated with the frequency converter/motor.

Table 12-17 Data type of parameter attributes

Data type	Description
U16	16-bit unsigned integer value
U32	32-bit unsigned integer value
I16	16-bit signed integer value
I32	32-bit signed integer value
Float	A simple-accuracy floating point value compliant with IEEE standard format Max. range of values: -3.39e+38 – +3.39e+38

Unit

On the frequency converter, the units associated with a specific parameter contain the physical variable (e.g., m, s, A). Variables are measurable properties/features of physical objects, procedures and statuses; they are represented by the terms of a formula (e.g., V = 9 V).

Table 12-18 Data type of parameter attributes

Unit	Description
-	Without dimension
%	Percent
A	Ampere
V	Volt
Ohms	Ohms
us	Microseconds
ms	Milliseconds
s	Seconds
Hz	Hertz
kHz	Kilo Hertz
rpm	Revolutions per minute (rpm)
m/n	Meters per second
Nm	Newton meter
W	Watt
kW	Kilowatt
hp	Horse power
kWh	Kilowatt hours
°C	Degrees Centigrade
m	Meter
kg	Kilogram
°	Degrees (angular degrees)

Quick commissioning

This parameter attribute indicates whether the parameter is part of quick commissioning (QC) (P0010 = 1).

Table 12-19 Quick commissioning parameter attributes

QC	Description
No	The parameter is not part of quick commissioning.
Yes	The parameter is part of quick commissioning.

Range of values

The range of values specified by the data type is limited by the minimum and maximum value (min., max.) and by the variables associated with the frequency converter/motor. Quick commissioning is dependent upon the parameters being set to default values. These values (min., max., def.) are permanently stored in the frequency converter and cannot be changed by the user.

Table 12-20 Range of values of parameter attributes

Range of values	Description
-	No value entered (e.g. "r-parameter")
Min	Minimum value
Max	Maximum value
Def	Default value

Data sets

You will find a more detailed description of the data sets in the corresponding section.

Table 12-21 Changeable parameter attributes

BICO	Description
CDS	Command data set
DDS	Drive data set

Potential groups

A potential group contains a power module and all modules located to the right of it as far as an ET 200pro terminating module or the next power module.

Note

Frequency converters and motor starters can be operated together in the same potential group.

Switch-off signal paths

The fail-safe frequency converter has two separate switch-off signal paths for the power electronics. All switch-off signal paths are low active, thereby ensuring that the system is always switched to a safe state if a component fails or in the event of an open circuit. If a fault is detected on the switch-off signal paths, the frequency converter is passivated. In this case, passivation cannot simply be acknowledged.

Two-channel monitoring structure

All the main safety-related hardware and software functions are implemented in two independent monitoring channels (e.g., switch-off signal paths, data management, data comparison).

Upload and download

Upload is understood to mean the saving of parameters from the EEPROM of a frequency converter to a PC (using STARTER) or to an MMC. Download is understood to mean the transferring of a parameter set saved on a PC or an MMC into the RAM or EEPROM memory of a frequency converter.

Writable parameters

Parameters that can be written and displayed are identified by the prefix "P".

These parameters have a direct impact on the behavior of a function. Their values are written to a non-volatile memory (EEPROM) if the corresponding option has been selected (non-volatile data storage). Otherwise, these values are written to the processor's volatile memory (RAM) and will be lost in the event of a power failure or restart.

Examples of the standard notation we always use in our manuals appear below.

Examples of notation:	
P0970	Parameter 970
P0748.1	Parameter 748, bit 01
P0819[1]	Parameter 819 index 1
P0013[0 ... 19]	Parameter 13 with 20 indices (indices 0 … 19)

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